POLYPORACEAE
OF NORTH AMERICA
The Genus Fomes

STATE UNIVERSITY COLLEGE OF FORESTRY
AT SYRACUSE UNIVERSITY

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OF NORTH AMERICA
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INTRODUCTION

The perennial bracket fungi, because of their size and persistence, have attracted attention from very early times. Medicinal value soon brought specific recognition to *Fomes officinalis,* which was well-known to the Greeks and the Romans. The context of some species, for example *F. fomentarius,* was impregnated with saltpeter and used as tinder. This practice accounts for the selection of the genus name which comes from the Latin word meaning tinder or kindling wood.

The destructive activities of wood-destroying fungi were unrecognized until late in the 19th century, when Robert Hartig established, chiefly with species of *Fomes,* the relation between hyphae, wood decay, and sporophores. Since then heartrot fungi, of which species of *Fomes* are important agents, have been recognized as the cause of enormous losses in timber, amounting, in 1952 in the United States and Alaska, to over seventy per cent of the damage due to fungi, and to one-third of the timber loss from all causes (Timber Resource Review 4A. 1955). In addition there are extensive wood decay losses in stored logs and wood products in use.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to the directors or curators of the herbaria cited on page 12 for the opportunity to study specimens at their institutions or through loan. Particular thanks are due the following institutions for extensive aid: Muséum National d'Histoire Naturelle, Laboratoire de Cryptogamie, Paris, France; the National Fungus Collections, at Beltsville, Maryland, where I have the honor to be a collaborator; the New York Botanical Garden, New York, N. Y.; the Riksmuseet, Stockholm, Sweden; and the Royal Botanic Garden at Kew, England. Special recognition are due Donald P. Rogers of the New York Botanical Garden and John Stevenson of the National Fungus Collections, for invaluable assistance throughout the study and for a critical reading of the manuscript.

ECONOMIC IMPORTANCE

Species of *Fomes* occur only on wood. The greater part of these are saprophytic, and play a highly beneficial role in slash disposal. On the other hand many species attack standing timber, causing heartrot, or, under favorable conditions, decay wood products. The rots caused by

species of *Fomes* in the North Temperate Zone are relatively well-known (Baxter, 1952; Boyce, 1948); on the other hand very little information is available on those caused by tropical species.

The heartrot fungi enter principally through branch scars or injuries where the bark is broken. Growth within the tree is slow, not exceeding a few inches longitudinally per year for many fungi. The external indications of decay, such as the presence of sporophores, swollen and punk knots, resinosis, cankers, etc., may be used to estimate the size of the rot column (Boyce, 1948, pp. 347-359; Silverborg, 1954). Though economic loss from wood decay is large, it should be remembered that harmful decay is a minor part of the indispensible and vastly beneficial cyclic process that replenishes carbon dioxide and other substances essential for green plant growth, which in turn supports all animal existence.

Species of *Fomes* belong to a very limited group of fungi capable of attacking wood and using it for food. By means of exoenzymes the fungus digests the wood, assimilates certain substances, and leaves a residue, the rotted wood, drastically altered both chemically and physically. There are two general types of wood rots, classified according to the wood components attacked or removed. The brown rots include those in which the cellulose and related polysaccharides of the cell wall are attacked, and the decayed wood is some shade of brown. Slight decay markedly alters the strength of the wood. In white rots all wood components are removed in differing proportions at different times, and the decayed wood is light-colored. The strength factor is more slowly altered, and frequently the affected wood is still usable in the early stages of decay. In a few types of white rots advanced decay is localized, forming pockets often lined with bleached cellulose fibers.

DISTRIBUTION

Distribution records for temperate North America are based on those of Overholts (1953), with supplements from my studies. Records for tropical North America are cited from specimens studied. Worldwide distribution records depend on those given by Cunningham (1948a, b), Lloyd (1915), and Pilát (1936-42), supplemented by my study of specimens, chiefly those in the Lloyd Herbarium at Beltsville.

Valid distribution records depend upon accurate determination of specimens. The species in the North Temperate Zone are usually those long known by tradition, or adequately represented by type material. With few exceptions, the identity of each of these is clear and its distribution quite certain. Tropical species, on the other hand, are often known from scanty material, and are frequently represented by sterile types. An extensive and detailed knowledge of tropical polypores has been possessed by very few workers, notably by Bresadola and Lloyd. Except for Lloyd's monograph (1915), comparative notes on the world flora are in scattered

and frequently inadequate references. The distribution records are incomplete and frequently invalid. It is known, however, that many tropical polypores have a wide distribution. More information is urgently needed. To supply this need in part, comparative notes are included, based on type material of similar species that grow in the tropics.

METHODS

The descriptions are based on the type specimens, if these could be found, supplemented by the variations found in additional material. Species whose types are not in existence conform to the current concepts of these in Europe and America, as exemplified by specimens identified by Bourdot, Bresadola, Patouillard, Romell and other European mycologists, and by the American specialists in the Polyporaceae. All specimens were examined for both macroscopic and microscopic characteristics. For the latter, observations were made from thin sections cut freehand with a razor blade, mounted first in ninety-five per cent ethyl alcohol to remove air and to wet the material, then in two per cent potassium hydroxide solution to swell it to normal size. Characteristics of the context tissue were obtained from sections cut parallel to the course of the hyphae, or from tissue teased apart with needles. Tubes were usually cut longitudinally to obtain tramal and hymenial details. Identification of additional fertile material of species whose types are sterile was made by direct comparison with type material.

MORPHOLOGY OF THE SPOROPHORE

Most specimens of *Fomes* may be recognized readily by their hard texture and the annual layers of the tubes. First-year sporophores may be distinguished from those of *Polyporus* and *Trametes* by their corky or somewhat firmer consistency. In many species the tissue hardens as it ages and becomes woody; it may be extremely heavy and rigid, as in *F. durissimus*. Sporophores may reach a very large size; *F. nobilissimus* forms one of the largest known, up to 100 cm. in width. In a few species, for example *F. scutellatus*, the fruiting bodies remain small, not exceeding 2 cm. in width. Small sporophores persist for only a few years at most; large ones may live for many years and have been reported to reach an age of sixty years in *F. officinalis*. The age is estimated from the number of tube layers, which can be seen most distinctly in vertical sections of the sporophores, and are sometimes indicated as well by concentric furrows on the upper surface. In some species sterile tissue may grow over the old tubes; new tubes are formed from this layer, thus producing a sharp separation of tube layers. Less marked contrasts occur, reaching their extreme modification in *F. fomentarius* and others, where there is little or no obvious break between old and new tube tissue.

Macroscopic Characteristics

Sporophores are composed of massed hyphae which form the sterile supporting tissue, the context and trama, and the fertile tissue, the hymenium. These hyphae periodically resume growth at the margin of the sporophore and at the ends of the tubes, forming the furrows on the upper surface and the tube layers. The macroscopic characteristics most useful in identifying species are the size, shape, and comparative weight of the sporophore, the size of the pores (FIGS. 14 and 15), the color and texture of the context, and the texture and distinctness of the tube layers (FIGS. 10, 39, 56). These provide a reasonably adequate basis for the determination of specimens from the North Temperate Zone. Microscopic details are necessary, however, for certain identification of many species. Determination of tropical specimens is very uncertain unless the microscopic characteristics are known. The modifications brought about by drought conditions due to high temperatures and by frequent insect damage, the abundance of superficially similar species, and lack of field knowledge make detailed microscopic examination imperative.

Microscopic Characteristics

Hyphae and the hymenial elements offer the most useful features. The hyphae of the context and trama have been intensively studied in recent years, and their modifications used in the taxonomy of the polypores. In this manual they are employed to characterize the species. Hyphal structure may vary much in a single sporophore, and adequate information has not been assembled to warrant using the hyphae as a basis of classification of taxonomic categories higher than the species. Setal hyphae (FIGS. 16 and 29) are of diagnostic value. In most species the tramal hyphae are very similar to the context hyphae and offer too little contrast to be useful in delimiting species.

The hymenial structures are critical, as in other genera of polypores. Spore characteristics in a species vary little; they are the most constant single structure known at present fixing the identity of a species. Spore color under the microscope is usually quite uniform and appears to offer, next to context color, the most satisfactory feature to separate the genus into subdivisions. Basidia are too uniform for the most part to serve in separating species; many of those species with brown context have basidia which agglutinate and form a pseudocellular tissue covering the trama. Sterile structures are often useful. Cystidia (FIG. 55) are rare in the species with white to rose context and, when present, are of diagnostic value. Setae (FIG. 43) may occur in all species with brown context. In some, however, setae are so rarely present that their absence may be used as a key character; setae, when present in aberrent samples, are usually scattered, subulate, and often obviously deformed. In making a determination all the characteristics of a specimen must be considered.

NOMENCLATURE AND TAXONOMY

Fomes is the only genus in the fungi segregated on account of the perennial nature of its sporophore. The genus is readily recognized by the non-specialist because of the layering of the tubes; first-year examples and those in which the tube layers are indistinguishable may be confused with specimens of *Polyporus* and *Trametes*, but can be recognized because of their corky to woody texture and, in old material, by their large size.

Fomes, as it is not based on a unique structural feature, is similar in its morphology to *Polyporus*, *Poria*, and *Trametes*. Unfortunately there can be no absolute demarcation of these genera. Within the genus attempts have been made to break the group into more natural segregates. The genera cited on page 14 include those more commonly used. Most of these were erected to treat the Polyporaceae of a restricted geographic area. These segregate genera introduced no new concept in classification; the characteristics employed had been in use to subdivide the original genus and in some at least, included so few species that such genera are scarcely practicable. A satisfactory system should take into account the polypores of the world, and ideally should consider all Hymenomycetes of similar structure.

In the present treatment the five sections represent what seem to be adequately distinct subgenera. The first has been segregated as the genus *Fulvifomes* Murr., the second as *Phellinus* Quél., and the fifth as *Fomitopsis* Karst. Previously sections three and four have been included in the first two of these genera, but these sections appear to be sufficiently distinct to warrant separate consideration.

In the arrangement of species, sporophores similar in appearance and structure are placed close to each other in the text. This juxtaposition often implies relationship, as nearly as this can be determined by morphological studies; equally often the position is simply a result of the key arrangement. The primary aim has been to facilitate identification.

In this manual sixty-eight species are recognized. No new species are described; however three new combinations are proposed, as follows:

Fomes johnsonianus (Murr.) from *Fomitiporella johnsoniana* Murrill
Fomes sancti-georgii (Pat.) from *Polyporus sancti-georgii* Patouillard
Fomes viticola (Schw.) from *Polyporus viticola* Schweinitz

Synonomy proposed, apparently for the first time, includes *Pyropolyporus hydrophilus* Murr. as a synonym of *F. sancti-georgii; Fomes cinereus* Rick, *F. longinquus* Lloyd, *F. olivaceus* Lloyd, and *Poria cinereo-umbrina* P. Henn., as synonyms of *F. lividus*. Species which appear to be new to the flora of North America include *F. allardii, F. durissimus, F. fastuosus, F. lividus, F. merrillii, F. noxius,* and *F. setulosus.*

DESCRIPTIONS AND KEYS

The Polyporaceae constitute a family of fungi within a larger group known as Basidiomycetes, each species of which has septate filamentous hyphae and bears the characteristic spores externally on a terminal cell called a basidium. Those basidiomycetes in which the hymenium lines the walls of cohering tubes are segregated into the Polyporaceae; and those pileate polypores that regularly persist for more than one season are placed in the genus *Fomes*.

The present location of type material is indicated after the citation of the original description. The first herbarium listed[1] contains the type unless qualified; the additional ones contain isotype material. Synonomy is based upon study of types or authentic material unless otherwise noted. The listing includes only specimens studied; additional isotypes no doubt exist, particularly at Kew and at the Farlow Herbarium.

FOMES (Fries) Kickx

Flore Crypt. Flandres 2:236. 1867. *Polyporus* ***** *(Fomes)* Fries, Summa Veg. Scand. 2, p. 321. 1849. *Phellinus* Quél., Ench. Fung., p. 172. 1886. *Mucronoporus* Ell. & Everh. in part, Jour. Mycol. 5:28. 1889. *Xanthochrous* Pat., Cat. Rais. Pl. Cell. Tunisie, p. 51. 1897. *Pyropolyporus* Murr., Torrey Bot. Club Bul. 30:109. 1903. *Nigrofomes* Murr., same, 31:425. 1904. *Porodaedalea* Murr., same, 32:367. 1905. *Elfvingiella* Murr., Northern Polypores, p. 52. 1914. *Fulvifomes* Murr., same, p. 49. 1914. *Oxyporus* (Bourd. & Galz.) Donk, Med. Nederl. Mycol. Verein 22:202. 1933. *Cryptoderma* Imazeki, Bul. Tokyo Science Mus. 6, p. 106. 1943[2].

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[1]Herbarium abbreviations are those of the *Index Herbariorum*, by J. Lanjouw and F. A. Stafleu, Utrecht, 1952. They are: BPI, National Fungus Collections, Beltsville, Maryland; FH, Farlow Library and Herbarium of Cryptogamic Botany, Cambridge, Mass.; FLAS, Agricultural Experiment Station, Gainesville, Florida; H, Botanical Museum, Helsinki, Finland; IA, State University of Iowa, Iowa City, Iowa; K, Kew Herbarium, Kew, England; MICH, University of Michigan, Ann Arbor, Mich.; NY, New York Botanical Garden, New York, N. Y.; NYS, New York State Museum, Albany, N. Y.; PAC, Pennsylvania State University, University Park, Pa.; PC, Muséum de Histoire Naturelle, Laboratoire de Cryptogamie, Paris, France; PH, Academy of Natural Sciences, Philadelphia, Pa.; S, Naturhistoriska Riksmuseet, Stockholm, Sweden; UPS, Botaniska Museet, Uppsala Universitet, Uppsala, Sweden.

[2]Genera listed here have been used in the taxonomy of North American species. Some additional genera in rather wide use are *Fomitopsis* Karst., *Ochroporus* Schroet., and *Ungulina* Pat.

Sporophores pileate, perennial for several to many years and often becoming large, consisting of context of various colors that supports layers of tubes ordinarily formed annually, indistinctly to very distinctly separated from each other; tubes opening by pores which vary from two to ten or more per mm. or rarely smaller, lined with a hymenium consisting of sterile elements such as cystidia and setae, and nonseptate basidia bearing smooth, hyaline to brown or rarely nearly black basidiospores.

Sporophores in their first year of growth may readily be confused with species of *Polyporus* but ordinarily can be distinguished by the firm to nearly woody texture. Some species are characteristically resupinate at first and become reflexed only in age, thus may be confused with perennial species of *Poria*.

Type species: *Polyporus fomentarius* L. ex Fries.

Polyporus fomentarius is the traditional tinder fungus of northern Europe and is an excellent example illustrating the literal meaning of the genus name.

KEY TO THE SECTIONS OF FOMES

1a. Context brown, varying from pale brown to yellowish- or reddish-brown 2a

2a. Spores distinctly colored ..... Section 1, page 15

2b. Spores hyaline ..... Section 2, page 38

1b. Context orange red or brick red ..... Section 3, page 62

1c. Context pink or rose ..... Section 4, page 65

1d. Context white or cream ..... Section 5, page 73

SECTION ONE

Context yellowish- or reddish-brown; spores distinctly colored, pale brown to brown-black.

The species in this section were segregated from *Pyropolyporus* and placed in the genus *Fulvifomes* by Murrill (1914, p. 49). Other mycologists have placed them in *Phellinus, Xanthochrous,* and *Cryptoderma.* Ordinarily the section is readily recognized, as the spores are usually found in abundance along the hymenium. The section is particularly well represented in the tropics, where it forms the largest and least understood group of species in the perennial polypores. The section is a heterogeneous one, united only by the colored context and colored spores. Within it there are groups of species so similar that they appear to be related; these are: *F. pectinatus* and *F. ribis; F. swieteniae* and *F. fastuosus; F. robiniae* and *F. merrillii; F. durissimus, F. grenadensis, F. pseudosenex,* and *F. troyanus;* and *F. badius* and *F. sanjanii.*

KEY TO THE SPECIES

1a. Setal hyphae present ..... 16. *F. portoricensis*
1b. Setal hyphae lacking
2a. Sporophore thin, conchate to applanate, or resupinate; spores minute, usually not exceeding 4 μ in greatest dimension (compare also 22. *F. dependens)*
3a. Setae present
4a. Sporophore conchate to applanate; setae 13-21 μ long; spores 3-3.5 μ wide ..... 18. *F. extensus*
4b. Sporophore at most slightly reflexed; setae 20-30 μ or more long; spores 2-3 μ wide .....23. *F. johnsonianus*
3b. Setae lacking
5a. Context duplex; pileus usually broadly sulcate, becoming large ..... 3. *F. ribis*
5b. Context homogeneous; pileus finely sulcate, small or medium-sized ..... 1. *F. pectinatus*
2b. Sporophore becoming applanate to ungulate; spores almost always 4 μ or longer in greatest dimension
6a. Spores very dark brown to brown-black in KOH ..... 9. *F. sublinteus*
6b. Spores pale yellowish to dark reddish brown in KOH
7a. Setae usually abundant, ventricose

8a. Pores 3-6 per mm.
9a. Spores dark reddish-brown in KOH; setae 13-35 × 6-11 μ ..... 19. *F. everhartii*
9b. Spores pale yellow brown; setae 20-50 × 6-14 μ ..... 20. *F. weirianus*
8b. Pores usually 6-10 per mm.
10a. Sporophore usually ungulate, pendent; context hyphae thick-walled, nonseptate ..... 22. *F. dependens*
10b. Sporophore applanate to convex, rarely somewhat ungulate
11a. Pileus sometimes becoming rimose above; tubes papery-fibrous; spores 4-5 μ long .... 21. *F. linteus*
11b. Pileus remaining smooth above; tubes cartilaginous, translucent; spores 5-6 μ long .... 17. *F. calcitratus*
7b. Setae lacking, or if present usually subulate
12a. Pores 2-5 per mm.
13a. Pores 2-5 per mm.; spores 5.5-7 × 4.5-6 μ ..... 14. *F. badius*
13b. Pores 2 per mm.; spores 4.5-5 × 3-4 μ . 15. *F. sanjanii*
12b. Pores usually 5 or more per mm.
14a. Sporophore light in weight; context hyphae usually thin-walled and conspicuously septate
15a. Pores 7-10 per mm.; spores 5-6 × 4.5-5.5 μ ..... 5. *F. fastuosus*
15b. Pores 5-8 per mm.; spores 4-5 × 3.5-5 μ ..... 4. *F. swieteniae*
14b. Sporophore medium to very heavy in weight; context hyphae (except 13. *F. durissimus*) usually thick-walled and rarely septate, or nonseptate
16a. Upper surface with a strong crust, at least in age
17a. Context hyphae 2-4 μ in diameter
18a. Pores 4-6 per mm. ..... 10. *F. grenadensis*
18b. Pores 8-9 per mm. ..... 11. *F. troyanus*
17b. Context hyphae 4-8 μ in diameter
19a. Context hyphae mostly nonseptate, 4-5 μ in diameter ..... 12. *F. pseudosenex*
19b. Context hyphae frequently septate, 4-8 μ in diameter ..... 13. *F. durissimus*
16b. Crust absent, the upper surface at most indurated in age
20a. Sporophore small, not over 3.5 cm. thick; context intensely colored, more or less fibrous
21a. Pileus applanate to convex; pores 7-10 per mm.; context hyphae 2.5-4 μ in diameter ..... 2. *F. allardii*

21b. Pileus ungulate; pores 5-8 per mm.; context hyphae 3-6 μ in diameter 8. *F. sancti-georgii*

20b. Sporophore becoming large; context dull yellowish- or reddish-brown, usually firm, not fibrous

22a. Pileus in age becoming glabrous and distinctly rimose, sometimes somewhat sulcate ..... 6. *F. robiniae*

22b. Pileus in age matted-velutinate, becoming somewhat cracked but not rimose, distinctly sulcate 7. *F. merrillii*

I. *Setae lacking or very rare*

A. *Sporophore conchate to convex, often rather small*

1. Fomes pectinatus (Klotzsch) Gill. FIG. 1

Champ. France 1:686. 1878. *Polyporus pectinatus* Klotzsch, Linnaea 8:485. 1833 (K-lectotype, NY-isotype). *Pyropolyporus subpectinatus* Murr., North Amer. Flora 9:109. 1908 (NY, BPI).

Sporophore effused-reflexed to sessile or rarely narrowed behind and substipitate, hard and woody; pileus conchate, up to 4 × 7 × 1 cm.; upper surface reddish-brown, at length darkening, densely pubescent, in time wearing off and exposing the dark layer below, finely sulcate, the margin thin, often lobed; pore surface yellowish- or reddish-brown, the pores round to angular, 8-12 per mm., edge becoming thin, entire. Context reddish-brown, firm, fibrous to somewhat fibrous, up to 3 mm. thick, with a black line above; tubes very indistinctly stratified, up to 3 mm. long in each layer.

Context hyphae rarely branched, usually thick-walled, with occasional cross walls, 3-5 μ in diameter; tramal hyphae thick-walled, nonseptate, 2.5-3.5 μ in diameter; setae none; spores hyaline, becoming pale brown, smooth, more or less globose, 2.5-3.5 μ in diameter.

On wood, presumably of angiosperms, in Mexico, Guatemala, British Honduras, Nicaragua, Costa Rica, Panama, Jamaica, Cuba, and St. Barthelemy Is.; widespread in the tropics. The rot is unknown.

The sporophore is very similar to that of *F. ribis*, which appears to be sufficiently distinct in its relatively larger size, broad sulcations, and duplex context. For a comparison with *F. allardii* and *F. caryophylli* (Racib.) Bres., see comments in the next description.

Additional synonomy appears to include *Polyporus boninanus* Pat., *P. pullus* Berk. & Mont., *P. substygius* Berk. & Br., and Bresadola considers *Trametes lilliputiana* Speg. the same.

2. Fomes allardii Bres. FIG. 2

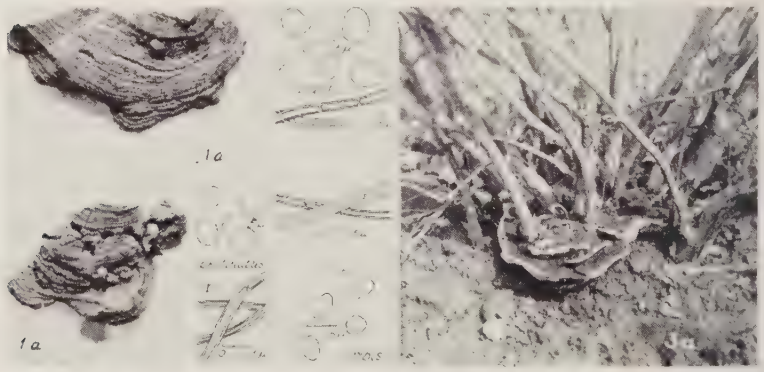
Jard. Bot. Bruxelles Bul. 4:19. 1911 (S, BPI, NY).

Sporophore solitary or somewhat imbricate, effused-reflexed to sessile, hard, of medium weight; pileus applanate to convex, up to 4 × 6 × 2 cm.; the upper surface reddish-brown or becoming black, sometimes grayish-pruinose, velvety-matted, usually becoming essentially glabrous, finely sulcate, azonate, the margin sometimes reddish-brown, velvety, obtuse; pore surface reddish-brown, the pores round, 7 or more often 8-10 per mm., edges thick to rather thin, entire. Context intensely reddish-brown, firm, somewhat fibrous, azonate, with a black line, above which is a softer tomentum that may wear away or may be indurated to form a distinct crust, up to 1 mm. thick; tubes in indistinct layers up to 3 mm. thick, firm-corky.

Context hyphae bright to rather dark reddish-brown in KOH, thin- to thick-walled, rarely and inconspicuously septate, 2.5-4 μ in diameter, with little or no connective hyphae, the tramal hyphae similar; setae none; spores distinctly reddish-brown, smooth, oblong-oval, 4-5 × 3-4 μ.

On wood, presumably of angiosperms, in Mexico, Cuba, Costa Rica, and in Africa. The rot is unknown.

Fomes pectinatus, F. allardii, and *F. caryophylli* (Racib.) Bres. have the same external appearance. Internally the context of the last two is much darker, with more slender context hyphae 2.5-4 μ in diam., and much darker spores. *F. allardii* and *F. caryophylli* are extremely similar, but the latter seems to differ in having smaller spores, 3.5-4 × 2.5-3.5 μ, and slightly more slender context hyphae, 2.5-3 μ in diameter. Further study may show that they are synonymous.



FIGS. 1a and 3a. — Habit, respectively, of *Fomes pectinatus* × 1 (isotype), and of *F. ribis* at the base of a diseased currant bush, photo courtesy of the Plant Pathology Laboratory, Canada Dept. Agriculture, St. Catherines, Ontario. FIGS. 1b and 3b. — Context hyphae and spores of the same species, 1b from isotype, 3b from Lowe 1549. FIG. 2. — Context hyphae and spores from type of *F. allardii.*

3. Fomes ribis (Schum. ex Fries) Gill. FIG. 3

Champ. France 1:685. 1878. *Boletus ribi* [*s*] Schum., Enum. Plant. Saell. 2:386. 1803. *Polyporus ribis* Schum. ex Fries, Syst. Myc. 1:375. 1821. *Pyropolyporus langloisii* Murr., Torrey Bot. Club Bul. 30:118. 1903 (NY -lectotype, BPI).

Sporophore solitary or somewhat imbricate, sessile, corky to subwoody; pileus applanate, up to 12 × 20 × 1.5 cm., the upper surface pale brown to black, glabrous, broadly sulcate, the margin velvety; pore surface brown, the pores round to angular, averaging 5-7 per mm., edges rather thick, entire. Context yellowish brown, with a lower firm portion separated by a thin black line from an upper soft part which may mat down or wear off, up to 10 mm. thick; tubes indistinctly stratified, up to 3 mm. long each season.

Context hyphae in the lower part rarely branched, thin- to thick-walled, septate, 2.5-4 μ in diameter, in the upper part thin-walled, septate, 3-6 μ in diameter, the tramal hyphae thick-walled, occasionally septate, 2-2.5 μ in diameter; setae none; basidia clavate, about 8-10 × 4-5 μ; spores pale brown, smooth, ellipsoid to subglobose, 2.5-4 × 2.5-3 μ.

At the base of living *Ribes,* also rarely on *Chionanthus, Crataegus, Lonicera, Maclura, Rosa,* and *Symphoricarpos* from Ontario and Rhode Island south to Maryland and west to the Mississippi, in Louisiana, Kansas, N. Dak., Montana, and Manitoba; and in Europe. This is the only species in the present series with a duplex context. *Fomes pectinatus* is similar but has a smaller sporophore with much finer sulcations, and a thin, more homogeneous context.

The rot is described by McCubbin, Rept. Canada Exp. Farms for year ending March 31, 1915, vol. 2 (appendix), pp. 969-973. 1916, and Stewart, N. Y. Agric. Exp. Sta. Geneva Bul. 463, p. 179. 1919. Spaulding's report (Science, N.S. 26:479-480. 1907) of this species on sassafras should be referred to *Polyporus licnoides* Mont.

Synonomy cited for this species includes *Polyporus lonicerae* Weinm., *P. evonymi* Kalchbr., *Phellinus versatilis* Quél., and *Ph. pectinatus* var. *jasmini* Quél. The species is evidently more common in Europe, where many forms are recognized.

AA. *Sporophores applanate to ungulate, usually becoming rather large*
a. *Pores averaging 5 or more per mm.*
b. *Crust absent or at most thin and weak*

4. Fomes swieteniae (Murr.) Rick FIG. 4

Broteria (ser. Bot.) 21, fasc. 1: 7 [or 30]. 1924. *Fulvifomes swieteniae* Murr., Tropical Polypores, p. 87. 1915 (NY, BPI).

Sporophore more or less imbricate, umbonate to sessile, firm to woody, light in weight; pileus applanate to ungulate, up to 20 × 15 × 11 cm., the upper surface yellowish brown or reddish brown, at first velvety to pubescent, becoming matted but not glabrous, appearing like a thin crust, smooth to rather coarsely cracked, the margin rounded, bright yellow-brown when actively growing; pore surface yellowish brown or reddish brown, the pores rounded to angular, averaging 5-8 per mm., edges becoming thin, entire. Context bright yellowish brown when fresh and remaining so, or changing to a dull pale reddish brown, fissile, not fibrous, with some thin black lines present, up to 4 cm. thick; tubes indistinctly stratified, up to 4 mm. long each season.

Context hyphae rarely branched, thin-walled, septate, 3-7 μ in diameter, the tramal hyphae thick-walled, 3-5 μ in diameter; setae none; basidia clavate, about 11 × 8 μ; spores distinctly reddish-brown, smooth, oval to subglobose, 4-5 × 3.5-5 μ.

On wood of angiosperms in Cuba (type), and also in Florida, Mexico, Guatemala, Costa Rica, and Trinidad. The thin crust formed by matting of the pubescence is unusual. The rot is unknown.

Fomes sulcteniae is difficult to separate from *F. fastuosus* and *F. endotheius* (Berk.) Cooke, both of which have smaller pores, 7-10 per mm., a softer and more fibrous context with usually wider hyphae 4-10 μ in diam., and larger spores, mostly 5-6 × 4-5 μ. Confusing intermediates occur however, and their exact relationship is unsettled.

5. Fomes fastuosus (Lév.) Cooke — Fig. 5

Grevillea 14:18. 1885. *Polyporus fastuosus* Lév., Ann. Sci. Nat. Bot. 3, 2:190. 1844 (BPI-isotype, S).

Sporophore solitary or somewhat imbricate, sessile, rigid, light in weight; pileus usually applanate or occasionally convex, up to 30 × 60 × 7 cm., the upper surface reddish brown, at first often velutinate, becoming matted, roughened and more or less glabrous, sometimes eventually forming a crust, usually sulcate, sometimes faintly and narrowly zonate, the margin usually acute, often bright yellow-brown, velvety, usually soon dulling; pore surface yellowish- or reddish-brown, dull, the pores round, 7-10 per mm., rarely larger to 5 per mm., the edges thick, entire. Context bright yellow-brown, in age duller, firm and corky, or more rarely soft or felty and fibrous, sometimes with a dark line above which may be a soft tomentum which, wearing off, may expose a thin crust, up to 3 cm. thick; tubes indistinctly stratified, fragile to corky, up to 9 mm. long in a layer.

Context hyphae bright cherry red in KOH, the walls thin to rather thick, frequently septate, 3-7 μ in diameter, connective hyphae usually little or none, the tramal hyphae similar except 3-5 μ in diameter; setae none; basidia clavate, about 11 × 8 μ; spores reddish-brown, smooth, oval to subglobose, 5-6 × 4.5-5.5 μ.

On hardwoods, associated with a conspicuous white pocket rot (see Imazeki in Jour. Jap. Bot. 16:583. 1940), from Florida, Mexico, Guatemala, British Honduras, Costa Rica, Panama, Jamaica, Cuba, Bahama Is., Puerto Rico, and Trinidad; apparently distributed throughout the tropics. Virtually unknown from North America previously, this species in fact appears to be our most common tropical Fomes. Many of Murrill's determinations of *F. extensus* belong here, as do my own of *F. pseudosenex.*

It can be inferred from the description that *F. fastuosus* is a highly variable species. Its typical condition is considered to be an applanate sporophore with velutinate upper surface and bright yellowish brown context. Older specimens very often thicken, roughen or form a crust, and the context may become duller and darker, and firmer. *Fomes swieteniae,* known with certainty only from the type, may be a form of it with more slender hyphae, smaller spores, and larger pores. *Fomes endotheius* (Berk.) Cooke differs principally in external characteristics of poor taxonomic value. The type of that species has a swollen nearly glabrous margin, behind which the surface is matted and essentially glabrous. The context hyphae are larger, 6-10 μ in diameter, with infrequent septa, and there is only a trace of a dark line in the context. These three species are so similar that they may be recognized eventually as forms of the same plant. Compare also *F. spadiceus* on p. 92.

According to specimens in the Farlow Herbarium, *Polyporus senex* of Berk. & Curt. Cuban Fungi, is this species. *Fomes rhytiphloeus* (Mont.) Cooke closely resembles it internally, but appears to distinctly differ in the pale hoary upper surface, darker rigid tubes, and pale yellow spores.

FIGS. 4a. — Habit of type specimen of *Fomes swieteniae,* × ½. FIG. 6a. — Upper surface and tubes of a typical specimen of *F. robiniae,* × ½ (specimen in College of Forestry Herbarium). FIGS. 4b, 5, and 6b. — Context hyphae and spores, 4b from type, 6b from the illustrated specimen. FIG. 5. — Context hyphae and spores from isotype of *F. fastuosus* (BPI).

6. Fomes robiniae (Murr.) Sacc. & D. Sacc. FIG. 6

Syll. Fung. 17:117. 1905. *Pyropolyporus robiniae* Murr., Torrey Bot. Club. Bul. 30:114. 1903 (NY-lectotype). *Pyropolyporus cedrelae* Murr., North Amer. Flora 9:105. 1908 (NY, BPI). *Fomes rimosus* (Berk.) Cooke of many authors, not *Polyporus rimosus* Berk.

Sporophore sessile, woody, of medium weight; pileus applanate to ungulate, up to 20 × 30 × 10 cm., the upper surface at first brown, velvety, darkening and becoming strigose, then glabrous, black and usually rimose with age, sulcate, the margin brown and velvety; pore surface brown, the pores round, 5-8 per mm., edges rather thick, entire. Context yellowish brown or reddish brown, usually with paler streaks, hard or softer and somewhat fibrous, up to 3 cm. thick; tubes indistinctly stratified, up to 4 mm. long each season.

Context hyphae rarely branched, thin- to thick-walled, occasionally septate, 3-5 μ in diameter; tramal hyphae thick-walled, nonseptate, 2.5-3 μ in diameter; setae lacking; spores dark reddish brown, smooth, broadly oval to subglobose, 4-5.5 × 3.5-5 μ.

Usually on living trees of *Robinia*, but on a few other hosts as well, from New York south and west to the Mississippi, in Iowa, Mo., Texas, New Mex., Ariz., and Calif.; in Mexico, Cuba, Bahama Is., Dominican Republic, Puerto Rico, and Jamaica; apparently very widely distributed in the tropics, rare in Europe. The fungus causes a yellow heartrot of locust, see Bagchee and Bakshi, Indian Forester 76:248-249. 1950; von Schrenk, Missouri Bot. Gard. Ann. Rept. 12:21-31. 1901, and von Schrenk and Spaulding, U. S. Dept. Agri. Plant Ind. Bul. 149:45-46. 1909.

The fungus described here is the one traditionally known as "*Fomes rimosus* (Berk.) Cooke". The application of Berkeley's name to this plant does not seem tenable. Murrill, in his original description of *Pyrop. robiniae*, emphatically states that *Polyporus rimosus* Berk. is a different plant. Berkeley's type, Drummond 144, is apparently lost, and the identity of the species logically should be based then on the implied paratypes. These are a Tasmanian and a Mauritius collection originally named *Polyporus igniarius* var. *scaber* by Berkeley in 1839. Berkeley's intent to base the species in part on the Tasmanian specimen seems obvious. This specimen, at Kew, is not the fungus described by Murrill. It has larger pores, mostly 4-5 per mm., and darker, softer, distinctly fibrous context, as well as marked microscopic differences, as thin-walled context hyphae 4-8 (-10) μ in diameter, and pale yellow-brown spores 6-7.5 × 5-5.5 μ.

Bresadola (Hedwigia 53:57. 1913), and Lloyd on a packet in his herbarium, have designated as true type the Tasmanian specimen. This concept of *F. rimosus* cannot be brought into accord with the concept traditional in North America.

The Mauritius specimen cited above is *F. robiniae* according to Bresadola and Lloyd, but, to me, this appears to be a coarsely rimose example of

the same fungus as the Tasmanian sporophore which has a scabrous upper surface. Both can be considered variants of *F. badius*.

7. Fomes merrillii (Murr.) Sacc. & Trott. FIG. 7

Syll. Fung. 21:287. 1912. *Pyropolyporus merrillii* Murr., Torrey Bot. Club Bul. 34:479. 1907 (NY, BPI).

Sporophore solitary, sessile, hard, of medium weight; pileus ungulate, up to 7 × 10 × 6 cm., the upper surface reddish-brown, matted-velutinate, sulcate, azonate, becoming more or less cracked but not rimose, the margin rounded, velutinate; pore surface yellowish- or reddish-brown, dull, the pores rounded to subangular, 4-6 per mm., the edges thick, entire. Context reddish-brown, fissile, usually firm but may be soft next to the tubes or when young, without a crust, up to 6 mm. thick; tubes subcorky, distinctly layered, each layer up to 10 mm. thick.

Context hyphae bright cherry red in KOH, rather thick-walled, nonseptate, 3-5 (-6) μ in diameter, with much connective hyphae; tramal hyphae 2.5-4 μ in diam.; setae none; spores dark brown, smooth, oblong-oval, 5-5.5 × 4-5 μ.

On wood, presumably of angiosperms, from Cuba and the Philippines. The type of decay is unknown.

The species closely resembles *F. robiniae* but has a less rimose upper surface which is also distinctly sulcate, persistently matted and velutinate, and eventually cracked but scarcely rimose. Lloyd (Myc. Writ. 4:283. 1915) places *F. merrillii* in synonomy with *F. endotheius* (Berk.) Cooke but, as Bresadola states (1926, p. 77), it is quite distinct from that species, especially in context color.

The type cited is Merrill 3575. Material under this number has not been found; Merrill 3570, in agreement with the original description except for the number, is considered the lectotype.

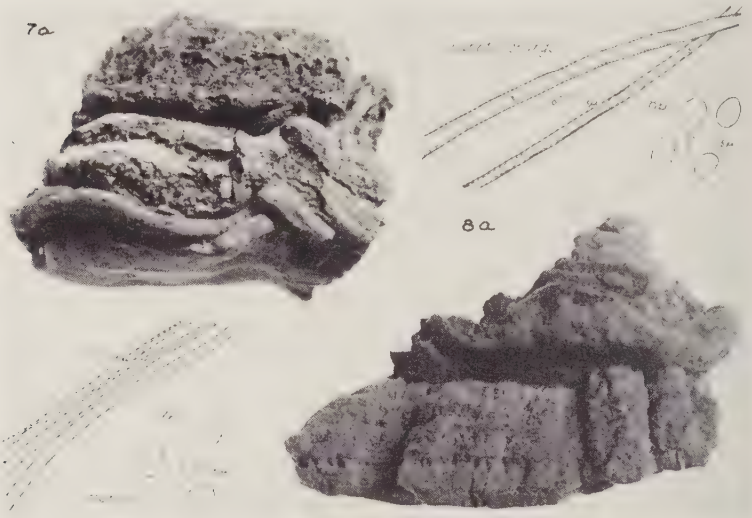
8. Fomes sancti-georgii (Pat.) Lowe, comb. nov. FIG. 8

Polyporus sancti-georgii Pat., Soc. Myc. France Bul. 11:207. 1895 (FH, BPI). *Pyropolyporus hydrophilus* Murr., Mycologia 2:195. 1910 (NY).

Sporophore sessile, woody; pileus ungulate, up to 3 × 6 × 3.5 cm., the upper surface dark reddish brown, at first or persistently tomentose, or older parts blackening and becoming glabrous, sulcate, the margin rounded; pore surface dark brown, the pores rounded, 5-8 per mm., the edges thick, entire. Context bright reddish-brown, distinctly fibrous, with a dark line above which occurs the softer surface layer, up to 1 cm. thick; tubes indistinctly stratified, papery- or corky-fragile, each layer up to 8 mm. thick.

Context hyphae thin- to rather thick-walled, infrequently septate, 3-6 μ in diameter, the tramal hyphae similar except 2.5-4 μ in diam.; setae none; spores reddish-brown, smooth, more or less oval, 4-5 $\times$ 3-4 μ.

On wood, presumably of angiosperms, in Jamaica and Venezuela. The rot is unknown. The species is very similar to *F. linteus* which differs in having setae, a less persistently tomentose pileus surface, and more distinctly septate context hyphae.



FIGS. 7a and 8a. — Habit respectively of type specimens of *Fomes merrillii* and *F. sancti-georgii*, both $\times$ 1. FIGS. 7b and 8b. — Context hyphae and spores from the same.

9. Fomes sublinteus (Murr.) Sacc. & Trott. FIG. 9

Syll. Fung. 21:291. 1912. *Pyropolyporus sublinteus* Murr., North Amer. Flora 9:110. 1908 (NY, BPI).

Sporophore sessile, brittle, light in weight; pileus applanate to convex, up to 10 $\times$ 15 $\times$ 4 cm., the upper surface brown to black, glabrous, smooth or nearly so, the margin rather thick, concolorous or "thin, rarely lobed, tomentose, ferruginous" (Murrill); pore surface dark brown, the pores angular, 6-7 per mm., walls thin, entire. Context bright yellow-brown (mustard color), rather soft, somewhat fissile but not fibrous, with a thin but distinct crust, up to 10 mm. thick; tubes in indistinct layers, each one up to 14 mm. thick.

Context hyphae thin-walled, septate, 3-6 μ in diameter, the tramal hyphae thick-walled, with rare inconspicuous cross walls, 3-5 μ in diame-

ter; setae none; spores very dark brown to brown-black in KOH, smooth, oval with one side usually somewhat flattened, 4.5-5 × 3.5-4.5 μ.

On wood of angiosperms, sometimes of living trees, in Louisiana, Texas, Mexico, Jamaica, and Cuba. The rot is unknown. Sporophores collected in the first year of growth (as in the type) could be classed as *Polyporus*. The spores are the distinctive feature, the darkest in the plants studied here.

Fomes rhytiphloeus (Mont.) Cooke (BPI specimen, presumed part of type) resembles this species but differs in having smaller pores, 8-10 per mm., somewhat larger context hyphae, 4-6 μ in diam., and pale yellow spores. A specimen at the Farlow Herbarium, also part of the type, has a matted velvety cover which is mentioned in the original description but which seems to be an abnormal condition or foreign growth.

bb. *Crust eventually thick and strong*

10. Fomes grenadensis (Murr.) Sacc. & Trott. FIG. 10

Syll. Fung. 21:292. 1912. *Pyropolyporus grenadensis* Murr., North Amer. Flora 9:107. 1908 (NY, BPI).

Sporophore solitary, sessile, very hard, light to medium in weight; pileus convex to more or less ungulate, up to 12 × 10 × 4 cm., the upper surface blackened, glabrous, smooth to checked and rimose, narrowly and shallowly sulcate, the margin acute to rounded; pore surface yellowish-brown to dark reddish-brown, the pores round to angular, 4-6 per m.m., the dissepiments entire, rather thick to rather thin. Context dark reddish-brown, rather soft-fibrous, with a black indurated layer above, up to 1 cm. thick; tubes in distinct layers, tough to rigid, up to 4 mm. thick in each layer.

Context hyphae thick-walled, nonseptate or rarely septate, 2-4 μ in diameter, the tramal hyphae very compactly arranged, sometimes almost pseudocellular, with thin to nearly solid walls, 2-4 μ in diameter; setae lacking; spores pale brown, smooth, oval to subglobose, minutely apiculate, 4-5 × 3-5 μ.

Presumably on wood of angiosperms, from Grenada (type) and Venezuela. The decay caused by this species is unknown.

The remarkably distinct tube layers characterize the species. The soft inner context contrasts sharply with the much firmer tubes. *F. grenadensis* is most similar to *F. pseudosenex* which may have indistinct layers of tubes, pores 8-12 per mm., context hyphae mostly 4-5 μ in diameter, and much darker spores.

This species has been placed in synonomy with *F. pachyphloeus* (Pat.) Bres. by Bresadola (1926, p. 79), on the basis of a specimen sent to him by Lloyd. This is a misconception as the type of *F. grenadensis* does not have the characteristic setal hyphae of *F. pachyphloeus*.

FIGS. 9a and 10a. — Respectively, upper surface of type of *Fomes sublinteus*, ×1, and vertical section of part of type material of *F. grenadensis*, ×1. FIGS. 9b and 10b. — Context hyphae and spores of the same.

11. Fomes troyanus (Murr.) Sacc. & Trott. FIG. 11

Syll. Fung. 21:289. 1912. *Pyropolyporus troyanus* Murr., Mycologia 2:196. 1910 (NY).

Sporophore sessile, hard, of medium weight; pileus convex to ungulate, up to 7 × 10 × 5 cm., the upper surface reddish-brown or in age blackening, glabrous, narrowly sulcate, smooth or in age cracking, somewhat rimose and with a crust, the margin usually paler; pore surface distinctly reddish-brown or glaucous in age, the pores round, 8-9 per mm. Context rather pale reddish-brown, hard, above indurated or sometimes with a true crust, up to 4 mm. thick; tubes distinctly stratified, each layer up to 5 mm. thick.

Context hyphae rather thick- to rather thin-walled, nonseptate, 2.5-3.5 μ in diameter; the tramal hyphae 2-3 μ in diameter; setae lacking; spores reddish-brown, smooth, oval, frequently flattened on one side, 4-5 × 3.5-4 μ.

On wood, presumably of angiosperms, in Jamaica. The decay caused is unknown. The sporophores externally resemble those of *F. pseudosenex*, but internally the latter has somewhat firmer, less prominently stratified tube layers, a much softer context, and context hyphae mostly 4-5 μ in diameter. *F. grenadensis* resembles it in many characteristics, but has larger pores, 4-6 per mm.

12. Fomes pseudosenex (Murr.) Sacc. & Trott. FIG. 12

Syll. Fung. 21:292. 1912. *Pyropolyporus pseudosenex* Murr., North Amer. Flora 9:107. 1908 (NY, BPI, FH).

Sporophore sessile, hard, heavy; pileus applanate, up to 20 × 20 × 5 cm., the upper surface reddish-brown and becoming black on older surfaces or black from the first, glabrous, sulcate; pore surface reddish-brown, the pores round, 8-12 per mm., edges thick or rather thick, entire. Context reddish-brown, soft-felty, varying to firm in part, up to 6 mm. thick, with a heavy black crust; tubes indistinctly or more commonly distinctly stratified, separated by a narrow to wide felty layer, up to 5 mm. long each season.

Context hyphae moderately thick-walled to thick-walled, nonseptate or with rare inconspicuous septa, mostly 4-5 μ in diameter, the tramal hyphae compactly arranged, thick-walled, nonseptate, 3.5-5 μ in diameter; setae absent; spores distinctly reddish-brown, smooth, broadly oval to globose, 3.5-5 × 3-4 μ.

On wood, presumably of angiosperms, in Nicaragua, Mexico, British Honduras, and Panama. The hard heavy sporophore with soft context under the thick rigid crust, nonseptate context hyphae, and the very compact tramal tissue seem to be the distinctive marks.

The identity of this fungus has been commonly misunderstood. Murrill, Lloyd and myself have considered it to be widely distributed and common. Interpreted in strict accord with the type material, it appears uncommon and of limited distribution. Specimens previously so named have been reassigned to several other species, notably to *F. fastuosus*. A white pocket heartrot at the base of angiosperms, described by Long in Torrey Bot. Club Bul. 66:625. 1939 and ascribed to *F. pseudosenex* by me (1955, p. 223), is of uncertain origin, as Long's specimens are of mixed identity, none of them now considered to be *F. pseudosenex*.

13. Fomes durissimus Lloyd FIG. 13

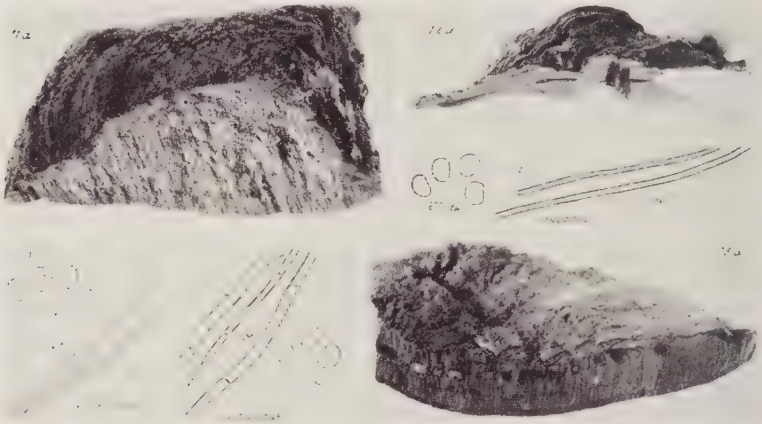
Mycol. Writ. 6:943. 1920 (BPI).

Sporophore solitary, sessile, relatively heavy and very hard; pileus applanate, up to 9 × 12 × 3 cm., the upper surface dull reddish-brown, blackening toward the base, more or less matted where young, this wearing away and exposing a hard crust, narrowly sulcate, the margin concolorous, acute; pore surface reddish-brown, the pores round, 7-10 per mm., edges thick, entire. Context reddish-brown, rather soft-fibrous below the thick crust, with cordlike paler areas, up to 8 mm. thick; tubes in indistinct layers which are up to 5 mm. thick, rather hard, fragile.

Context hyphae thin- or rather thin-walled, with frequent cross walls, uniform or frequently variable in diameter, 4-8 μ, with rare to abundant connective hyphae, the tramal hyphae compactly arranged, mostly thick-

walled, 3-4 μ in diameter; setae none; spores rather pale brown to distinctly brown, smooth, oval, sometimes flattened on one side, 4-5 × 4-4.5 μ.

Known from one collection from Cuba, presumably on angiosperms; described from Africa and reported by Lloyd from the East Indies as well. The rot is unknown. The species is very similar to *F. pseudosenex* which may be distinguished by its thicker-walled nonseptate hyphae and the usually slightly smaller spores.



FIGS. 11a, 12a, 13a. — Habit, respectively, of type specimens of *Fomes troyanus*, *F. pseudosenex*, and *F. durissimus*, × ⅔, × ⅓, and × ⅔. FIGS. 11b, 12b, 13b. — Context hyphae and spores from the same.

aa. *Pores averaging less than 5 per mm.*

14. Fomes badius (Berk.) Cooke FIG. 14

Grevillea 14:18. 1885. *Polyporus badius* Berk., Ann. and Mag. Nat. Hist. 7:453. 1841 (K, BPI, NY). *Xanthochrous igniarioides* Pat., Soc. Myc. France Bul. 14:54. 1898 (FH, BPI). *Pyropolyporus underwoodii* Murr., Torrey Bot. Club Bul. 30:116. 1903 (NY, BPI). *Fomes subendotheius* Bres., Ann. Mycol. 8:589. 1910 (S, BPI). *Pyropolyporus melleicinctus* Murr., N. Y. Bot. Gard. Bul. 8:150. 1912 (NY, BPI).

Sporophore sessile, woody; pileus convex to ungulate, up to 9 × 18 × 10 cm., the upper surface grayish-black to blackish-brown, becoming somewhat cracked or distinctly rimose or fissured behind, somewhat sulcate, the margin yellowish-brown or reddish-brown, velvety, soon matted or glabrous, smooth, obtuse; pore surface pale brown to dark reddish-brown or dark brown, the pores rounded, 2-5 per mm., edges rather thick to rather thin, entire. Context yellowish-brown or reddish-brown, subshiny, woody, somewhat fissile, fibrous or not at all fibrous, sometimes

with a thin black line above, up to 2 cm. thick; tubes in very indistinct layers, 5-20 mm. long each season, papery-fibrous or rarely firmer and corky, old tubes stuffed with yellowish- or reddish-brown hyphae.

Context hyphae rarely branched, thin- to thick-walled, septate or nonseptate, 4-8 μ in diameter; tramal hyphae as in context but more slender, 2.5-4 μ in diameter, nonseptate; setae lacking (or in type of *P. underwoodii* rare, subulate, 25-30 $\times$ 5-6 μ); spores pale to dark reddish-brown, smooth, oval to subglobose, 5.5-7 $\times$ 4.5-6 μ.

Usually on leguminous trees, often living, in Texas, Arizona, Mexico, Cuba, Dominican Republic, Bahama Is., Puerto Rico, and Curaçao; reported as widely distributed in the tropics. The rot is described for a variety of substrata by Bagchee and Bakshi (Indian Forester 76:247-248. 1950). In comparison with the species included in this manual, *F. badius* is most similar to *F. sanjanii* which has larger pores, about 2 per mm., and smaller spores, 4.5-5 $\times$ 3-4 μ. *F. robiniae* is also very similar but has a usually more rimose upper surface, pores 5-8 per mm., context hyphae 3-5 μ in diam., and spores 4-5.5 μ long.

Fomes badius is in a complex of several very similar species agreeing in having spores averaging more than 5 μ in the longest dimension. *F. pappianus* Bres. seems to differ only in having a grayish upper surface and a distinct crust. *F. dialeri* Bres. & Torr., later considered by Bresadola (herbarium note) as perhaps only a form of *F. pappianus*, seems to differ in having an intensely colored rusty brown context with hyphae 3-5 μ in diam., and spores 5-5.5 $\times$ 4-4.5 μ. *F. aulaxinus* Bres. (*F. mc gregori* Bres. a synonym) resembles smooth forms of this species but differs in having distinctly more slender context hyphae 2-3 μ in diam. *Xanthochrous niaouli* Pat. differs in having the upper surface matted-hirsute. *F. scaber* (Berk.) Lloyd seems to differ from *X. niaouli* principally by the nature of the upper surface, which is pruinose, somewhat scabrous and, in the older portion, somewhat cracked and rimose. *F. scaber* may be a form of *F. badius*.

The type of *F. badius* was said to come from Arctic North America, a labelling mistake most certainly, for this species is typically tropical in its distribution and only barely extends into the Temperate Zone.

15. Fomes sanjanii Lloyd FIG. 15

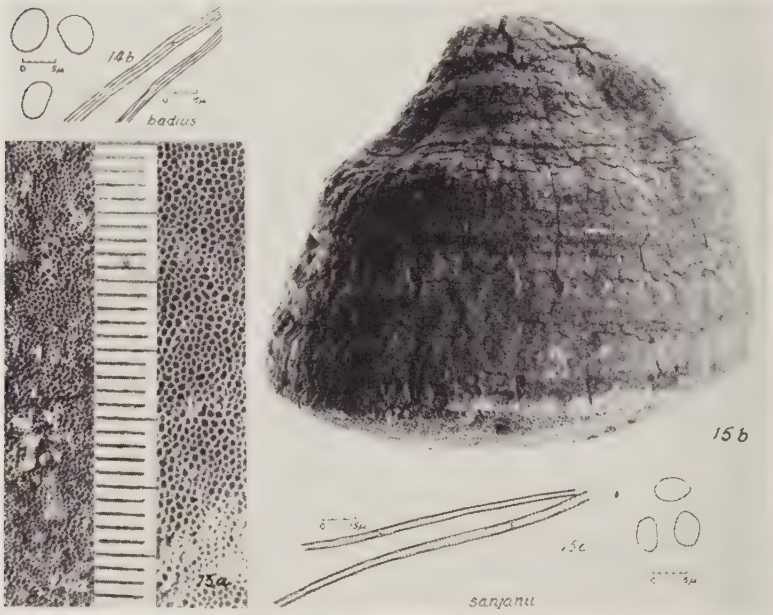
Mycol. Writings C. G. Lloyd 6:885. 1919 (BPI-lectotype).

Sporophore solitary, sessile, woody; pileus more or less ungulate, probably rather large, up to 8 $\times$ 12 $\times$ 8 cm., the upper surface reddish-brown to blackish, glabrous, somewhat cracked; pore surface reddish-brown, the pores rounded, 2 per mm., edges moderately thick, entire. Context shining reddish-brown, in part soft-fibrous, in part indurated, brittle, up to 1 cm. thick; tubes indistinctly stratified, each layer up to 2 cm. thick.

Context hyphae rarely branched, thin- to thick-walled, with occasional septa, 3-5 μ in diameter, the tramal hyphae similar except somewhat more

slender, 2-4 μ in diameter; setae none; spores reddish-brown, smooth, oblong-ellipsoid, 4.5-5 × 3-4 μ.

On wood, presumably of angiosperms, in Cuba and St. John Is., West Indies. The rot is unknown. The specimen illustrated by Lloyd is apparently lost; Lloyd Herbarium No. 45418 from Cuba has been selected as lectotype. The sporophore is very similar to *F. badius* which has, however, somewhat smaller pores, 2-5 per mm., and larger spores, 5.5-7 × 4.5-6 μ.



FIGS. 14a and 15a. — Pore surface, respectively, of *Fomes badius* (specimen coll. P. H. Orcutt, BPI) and of *F. sanjanii* (lectotype — Lloyd Herb. no. 45418), both × 1.8. FIG. 15b. — Habit of *F. sanjanii* × 9/10, same specimen. FIGS. 14b and 15c. — Context hyphae and spores from the same specimens.

II. *Setae infrequent to abundant*

B. *Setal hyphae present*

16. Fomes portoricensis Overh. FIG. 16

In Seaver and Chardon, Sci. Survey Porto Rico and Virgin Is. 8(1): 158. 1926 (NY). *Fomes melanodermus* (Pat.) Sacc. & Syd. var. *tomentosus* Bres., Ann. Mycol. 10:497. 1912 (S, BPI).

Sporophore sessile or somewhat effused, woody; pileus applanate, up to 6 × 10 × 2 cm., the upper surface reddish-brown, blackening more or less in the older portions, velvety or matted at the margin and this

persisting several years on top of sulcations, in the depressed part soon glabrous and usually blackening, mostly distinctly and narrowly sulcate; pore surface pale chocolate brown to dark brown, the pores round to somewhat angular, 8-10 per mm., edges thick, sometimes becoming rather thin, entire. Context yellowish- or reddish-brown with a distinct, rather thick black line above, firm but not hard, faintly zonate, with occasionally darker zone lines extending downward from the black line, fissile but not at all fibrous, with minute dark streaks readily visible at 17 × (the setal hyphae), up to 5 mm. thick, sometimes interspersed in older context with white anastomosing lines; tube layers faintly or distinctly separated by a line of tissue, up to 8 mm. long each season.

Context hyphae rarely branched, rather thin-walled, rarely septate, 3-6 μ in diameter, mixed with frequent setal hyphae 8-19 μ in diameter, the tramal hyphae similar except 2.5-3.5 μ in diameter; setae abundant, ventricose, 16-25 × 5-8 μ; setal hyphae also frequently projecting into tubes; spores pale, soon distinctly reddish brown, smooth, oval, usually flattened on one side, 4-5 × 3.5-4 μ.

On wood, presumably of angiosperms, in Mexico, Costa Rica, Panama, Cuba, Puerto Rico, and Java. This species is unique in the colored-spored group in having setal hyphae. First described as a variety, it is quite different from *F. melanodermus* which has a well-developed glabrous crust, and smaller spores 3-4 μ in diameter. The rot is unknown.

Setal hyphae occur in a few other species of *Fomes*. Herbarium specimens of these are almost invariably sterile, but are said to have hyaline

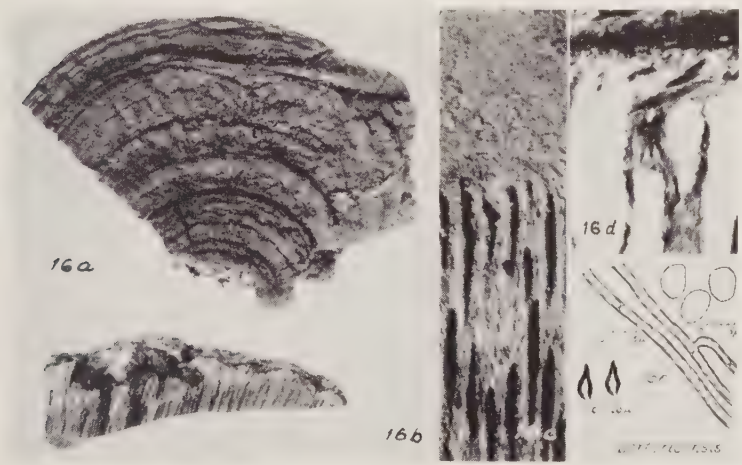


FIG. 16. — *Fomes portoricensis*. a-c. Specimen collected by C. L. Smith, no. 228 (NY). a-b. Upper surface and sectional view × 1. c-d. Vertical section of context and tubes showing setal hypae, × 18 and × 50 respectively. e. Context hyphae, setae, and spores from the type specimen.

or pale spores. *F. pachyphloeus* (Pat.) Bres. produces a much larger sporophore, with a distinct crust over a feltlike context, and pores 6-7 per mm. *F. lamaensis* (Murr.) Sacc. & Trott. and *F. noxius* Corner differ in having tubes which are rigid and markedly darker than the context.

BB. *Setal hyphae absent*

b. *Upper surface more or less smooth, velvety or glabrous and with a crust*

17. Fomes calcitratus (Berk. & Curt.) Cooke FIG. 17

Grevillea 14:20. 1885. *Polyporus calcitratus* Berk. & Curt., Linn. Soc. Bot. Jour. 10:314. 1868 (K, FH, NY). *Pyropolyporus jamaicensis* Murr., Torrey Bot. Club Bul. 30:120. 1903 (NY, BPI).

Sporophore sessile or somewhat effused, woody, of medium weight; pileus applanate to convex, up to 11 × 11 × 5 cm., the upper surface yellowish-brown, velvety and often persisting, or becoming matted and essentially glabrous, the margin thinning down but remaining rounded, even; pore surface reddish-brown or more often darker to brownish-black, very slightly glistening, the pores round to angular, averaging 7-9 per mm., edges thick or becoming rather thin, entire. Context yellowish-brown or reddish-brown, subshining, radially fibrous, with a well-developed black line above, up to 10 mm. thick, the tubes appearing translucent, cartilaginous, very distinctly layered with context tissue between each layer, up to 12 mm. long each season.

FIGS. 17a and 18a. — Habit, respectively, of type of *Fomes calcitratus*, and of *F. extensus* from Montserrat (Shafer 876, at NY), both × 1. FIGS. 17b and 18b. — Context hyphae, setae, and spores of the same, except 18b from the isotype specimen (NY).

Context hyphae rarely branched, thin-walled to nearly solid, septate, 3-6 μ in diameter, the tramal hyphae rather thin-walled, 2-3.5 μ in diameter; setae usually present, narrowly to broadly ventricose, 13-25 $\times$ 5-8 μ; spores pale yellowish-brown or rarely some to reddish-brown, subglobose, smooth, 5-6 $\times$ 4-5 μ.

On wood, presumably of angiosperms, in British Honduras, Cuba, Jamaica, Bermuda Is., Trinidad, and Brazil. The rot is unknown. The somewhat translucent, cartilaginous-appearing tubes are the most distinctive mark of the species. *F. linteus* is very similar but differs in having a thicker pileus, a silky, dark reddish brown context without a black line above, soft tubes, and somewhat smaller spores, 4-5 $\times$ 3-5 μ. *F. troyanus* has similarly distinct layers of tubes, but is characterized by usually larger sporophores, darker smaller spores 4-5 $\times$ 3.5-4 μ, and more slender context hyphae 2.5-3.5 μ in diameter.

The type specimen of *P. jamaicensis* lacks setae but otherwise is very similar to *F. calcitratus*. *P. jamaicensis* perhaps more closely resembles *F. rhytiphloeus* (Mont.) Cooke which differs only in the sometimes matted-velvety, sordid white upper surface (perhaps not a normal feature) and a brighter yellow-brown context.

18. Fomes extensus (Lév.) Cooke

FIG. 18

Grevillea 14:18. 1885. *Polyporus extensus* Lév., Ann. Sci. Nat. Bot. 3, 5:129. 1846 (PC, BPI, NY, S).

Sporophore sessile, woody; pileus conchate to applanate, up to 5 $\times$ 7 $\times$ 0.7 cm., the upper surface reddish-brown and blackening, of agglutinated fibers, faintly to strongly sulcate, the margin rather thick, even; pore surface reddish-brown, the pores round to angular, 8-11 per mm., edges thick, entire. Context reddish-brown with a thick black line above, soft to firm, scarcely fissile, up to 5 mm. thick; tubes indistinctly stratified, up to 2 mm. long in each layer.

Context hyphae rarely branched, thick-walled, nonseptate, 2.5-4 μ in diameter; tramal hyphae 2.5-3 μ in diameter, thick-walled, nonseptate; setae frequent, in large part imbedded, ventricose, 13-21 $\times$ 7-9 μ; spores pale yellowish-brown, smooth, subglobose, 3.5-4 $\times$ 3-3.5 μ.

On wood, presumably of angiosperms, in Nicaragua, Cuba, Haiti, Dominican Republic, Guadeloupe, Montserrat, and Brazil. A brown mottled rot was associated with the Brazilian specimen. The essential characters of the species appear to be the thin applanate habit, the slender context hyphae, and the small setae. The species has been very badly confused. Murrill, Lloyd, and Overholts uniformly misapplied the name, and no specimens so named by them correspond to the type material.

The decay ascribed to this fungus by Long (Torrey Bot. Club Bul 66:625. 1939) is of uncertain origin, as his specimens includes several species, none of them *F. extensus*.

According to a specimen determined by Bresadola, *F. nilgheriensis* (Mont.) Bres. is very similar if not synonymous with this species. If a synonym, *F. nilgheriensis* would be the earlier valid name.

bb. *Upper surface typically rimose in age*

19. Fomes everhartii (Ell. & Gall.) von Schrenk & Spauld. Fig. 19

U. S. Dept. Agr. Pl. Ind. Bul. 149:48. 1909. *Mucronoporus everhartii* Ell. & Gall., Jour. Myc. 5:141. 1889 (BPI, NY). *Pyropolyporus praerimosus* Murr., Torrey Bot. Club Bul. 30:115. 1903 (NY, BPI).

Sporophore sessile, woody; pileus more or less ungulate, up to 15 × 30 × 15 cm., the upper surface at first uniformly yellowish-brown, becoming grayish-black or black, smooth but cracked or varying to very rough and rimose, glabrous, sometimes sulcate, the margin brown, velvety, obtuse; pore surface yellowish- to reddish-brown, the pores round to angular, 3-6 per mm., edges thin, entire. Context reddish- or yellowish-brown, faintly zonate, scarcely fibrous but fissile, up to 4 cm. thick; tubes indistinctly stratified, becoming more or less white-incrusted within, up to 7 mm. long in each layer.

Context hyphae rarely branched, usually thin- or rather thin-walled, frequently septate, 3-5 μ in diameter; setae abundant to rare, mostly ventricose, 13-35 × 6-11 μ; spores usually dark reddish-brown, smooth, oval to subglobose, 4-5 × 3-4 μ.

Usually on living trees, rarely on down logs, of angiosperms, particularly oaks, from Ontario and N. H. southward and westward to the Mississippi and in Ark., Mo., Iowa, Kansas, Nebr., Mont., and N. Mex. *F. weirianus* is very similar externally but has longer setae, 20-60 μ in length, and pale yellow-brown spores. *F. lintens* also often resembles it but is ordinarily more applanate, with smaller pores, usually 6-8 per mm., a silky-glistening context, and pale golden-brown spores.

The fungus produces a white heartrot, see Graves, Mycologia 11:120-121. 1919; Hedgcock, Phytopathology 2:74-75. 1912; Hirt, Mycologia 22:310-311. 1930; and von Schrenk and Spaulding, U. S. Dept. Agr. Bur. Pl. Ind. Bul. 149:48. 1909.

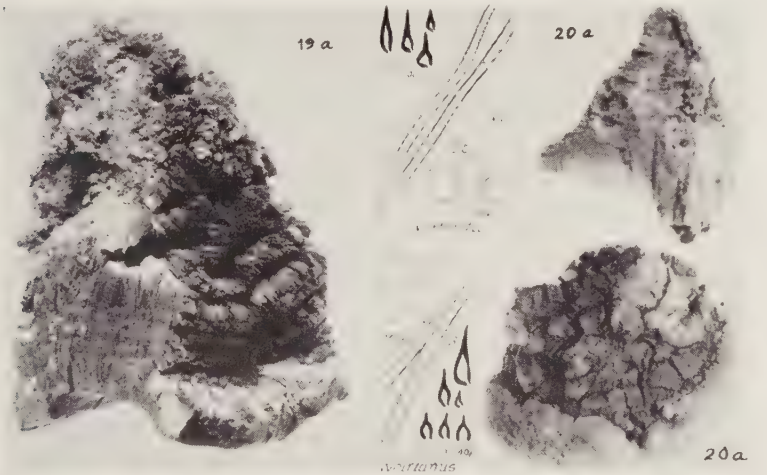
20. Fomes weirianus Bres. Fig. 20

Studi Trentini 2,7(1):55. 1926 (BPI-isotype).

Sporophore sessile, woody; pileus ungulate, up to 3 × 8 × 8 cm., the upper surface grayish-black, glabrous, strongly rimose, sulcate, the margin yellowish-brown, tomentose; pore surface yellowish-brown, the pores round, 5-6 per mm., edges rather thick, entire. Context bright yellowish-brown, hard, fissile, up to 3 cm. thick; tubes indistinctly stratified, each layer up to 7 mm. thick.

Context hyphae with walls of moderate thickness, occasionally septate, 3-5 μ in diameter, the tramal hyphae similar, 3-4 μ in diameter; setae infrequent, subventricose, 20-50 ("-60", Bresadola) $\times$ 6-14 μ; spores pale yellow-brown, smooth, ellipsoid to subglobose, 4-5 $\times$ 3.5-4 μ.

On wood of angiosperms, known from Arizona and New Mexico. The rot is unknown. The species is very similar to *F. everhartii* which appears to differ in having smaller setae, 13-35 $\times$ 6-11 μ, and in the dark reddish-brown spores. Less markedly rimose specimens resemble *F. linteus* which differs in having smaller setae, 11-25 $\times$ 4-9 μ.



FIGS. 19a and 20a. — Habit, respectively, of the type of *Fomes everhartii* ($\times$ ½), and isotype of *F. weirianus* ($\times$ ⅔). FIGS. 19b and 20b. — Context hyphae, setae, and spores from the same.

21. Fomes linteus (Berk. & Curt.) Cooke FIG. 21

Grevillea 14:20. 1885. *Polyporus linteus* Berk. & Curt., Proc. Amer. Acad. [Boston] 4:122. 1860 (K, BPI, FH, NY). *Pyropolyporus yucatanensis* Murr., Torrey Bot. Club Bul. 30:119. 1903 (NY, BPI).

Sporophore sessile, woody; pileus applanate to ungulate, up to 12 $\times$ 21 $\times$ 8 cm., the upper surface dark reddish-brown, matted-tomentose and this persisting in older portions, sometimes becoming gray or black and rimose, sulcate, the margin rounded; pore surface dark reddish-brown, the pores round to subangular, (4-) 6-8 per mm., edges thick to thin, entire. Context bright reddish- or yellowish-brown, silky-glistening, rather hard, fissile and distinctly fibrous, darkening at the upper surface but not forming a black line, up to 10 mm. thick; tubes in indistinct layers, papery-fibrous, up to 15 mm. long in each layer.

Context hyphae rarely branched, thin- or rather thin-walled, with frequent cross walls, 3-6 μ in diameter, the tramal hyphae rarely branched,

thick-walled, occasionally septate, 2.5-5 μ in diameter; setae infrequent to abundant, broadly to narrowly ventricose, sometimes subulate, 11-25 × 4-9 μ; spores nearly hyaline to pale golden brown or some becoming dark rusty brown, smooth, broadly oval to globose, 4-5 × 3-5 μ.

On wood, presumably of angiosperms, in Texas, Mexico, Nicaragua, Costa Rica, Panama, Cuba, Bahama Is., Puerto Rico, Trinidad, and Brazil. The rot is unknown.

The silky-fibrous context, usually somewhat ventricose setae, and pale spores are the distinctive characteristics of the species, which is, however, a variable and frequently confusing one. Ungulate, large-pored forms with slender setae resemble the setulose forms (*Pyrop. underwoodii*) of *F. badius* which can be distinguished by their larger spores, 5.5-7 × 4.5-6 μ; forms with rare or apparently absent setae should be compared with *F. sancti-georgii* which has a more persistently tomentose pileus, and less distinctly septate context hyphae.

22. Fomes dependens (Murr.) Sacc. & Trott. FIG. 22

Syll. Fung. 21:292. 1912. *Pyropolyporus dependens* Murr., North Amer. Flora 9:106. 1908 (NY, BPI).

Sporophore usually more or less pendent, hard and heavy; pileus ungulate, up to 5 × 12 × 7 cm., the upper surface blackened, more or less rimose and sulcate, the margin narrow, often receding each year; pore surface reddish-brown, the pores rounded to angular, 7-9 per mm., edges becoming thin, entire. Context yellowish- or reddish-brown, scarcely fibrous, up to 2 mm. thick; tubes in indistinct layers, up to 5 mm. long each season.

Context hyphae rarely branched, thick-walled to nearly solid, nonseptate, 3-4 μ in diameter, the tramal hyphae similar, 2.5-4 μ in diameter; setae usually abundant, narrowly to broadly ventricose, 11-16 × 5-8 μ; spores pale reddish-brown, smooth, broadly oval to subglobose, 3.5-4 × 2.5-4 μ.

On the wood of angiosperms in Florida, Mexico, Nicaragua, Cuba, and Puerto Rico; reported also from Brazil. The rot is unknown.

This species may be distinguished by its pendent habit of growth, heavy weight, and small pale spores. It is most similar to *F. johnsonianus* which has, in contrast, a resupinate to scarcely reflexed habit, and larger setae, mostly 19-24 μ long. *F. pseudosenex* has been confused with *F. dependens* but differs by having a hard crust with underlying soft context, the absence of setae, and darker, somewhat larger spores usually 4-5 μ long.

23. Fomes johnsonianus (Murr.) Lowe, comb. nov. FIG. 23

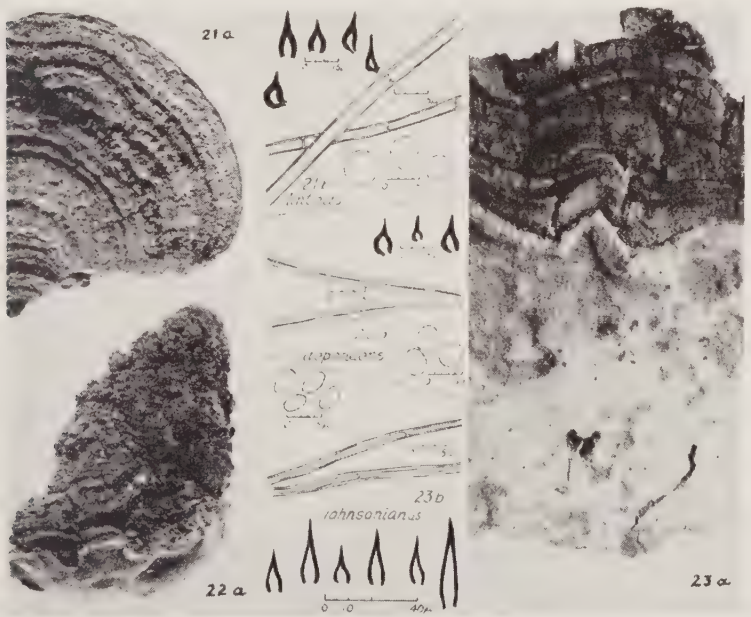
Fomitiporella johnsoniana Murr., N. Amer. Flora 9:13. 1907 (NY, BPI, FH).

Sporophore resupinate or slightly reflexed, of medium weight; pileus often widely effused, rarely reflexed up to 2.5 cm., up to 3 cm. thick, the upper surface brownish to black, glabrous, closely sulcate, the margin paler, often bright yellow-brown, velvety, narrow; pore surface yellowish- or reddish-brown, the pores round, 8-10 per mm., edges rather thick. Context bright yellowish- or reddish-brown, firm, up to 2 mm. thick; tubes indistinctly stratified, up to 5 mm. long in each layer.

Context hyphae thin- to rather thick-walled, occasionally septate, 2.5-4 μ in diameter, tramal hyphae similar except 2-4 μ in diameter; setae frequent to rare, more or less ventricose, usually 20-30 × 6-8 (13-40 × 5-11) μ; spores pale brown, smooth, ellipsoid to broadly oval, 2.5-4 × 2-3 μ.

On the wood of angiosperms in D.C., Virginia, Ohio, Michigan, Louisiana, Missouri, Iowa, and Ontario. The rot is unknown.

This fungus is most similar to *F. dependens* which is decidedly heavier, pendent, and with smaller setae, 11-16 × 5-8 μ. *Fomes densus* Lloyd as described by Overholts (1953, p. 80) is this species; Lloyd's specimens are thick heavy forms of *F. conchatus*. Weir distributed resupinate material of this as *Poria pereffusa* (Murr.) Sacc. & Trott.



FIGS. 21a, 22a, 23a. — Habit, respectively, of half of the type of *Fomes linteus* (× 1), isotype of *F. dependens* × 1 (BPI), and an unusually well-developed specimen of *F. johnsonianus* × ½ (photo by L. O. Overholts, No. 965). FIGS. 21b, 22b, and 23b. — Context hyphae, setae, and spores from the same specimens.

SECTION TWO

Context varying from pale brown to yellowish- or reddish-brown or dark purple-brown; spores hyaline, sometimes coloring in age.

The species in this section have been placed in the genera *Elfvingia* and *Elfvingiella, Nigrofomes, Porodaedalea,* and *Pyropolyporus* by Murrill (1907-08, 1914, 1915 a, b, c). In present European mycology these species are included in the genus *Phellinus.* The group is a large one, with species well represented in both the temperate and tropical areas. It is heterogeneous in nature, as most of the species show little similarity to each other. The following appear to be closely related: *F. melanoporus* and *F. lividus; F. fomentarius* and *F. sclerodermeus; F. igniarius* and *F. pomaceus;* and *F. zealandicus* and *F. setulosus.*

KEY TO THE SPECIES

1a. Context entirely or in part dark purplish-brown
  2a. Sporophore usually distinctly reflexed or sessile; pores 6-8 per mm.; context dark purple-brown throughout; spores 4-5 × 2.5-3 μ ..... 24. *F. melanoporus*
  2b. Sporophore usually resupinate; pores 4-6 per mm.; context pale brown, usually in part purple-brown; spores 5-7 × 3.5-5 μ ..... 25. *F. lividus*

1b. Context yellowish-brown or reddish-brown
  3a. Pileus with a thick crust; context soft, fibrous or punky
    4a. Pores about 3 per mm.; spores 17-20 × 5-6 μ ..... 27. *F. fomentarius*
    4b. Pores 4-6 per mm.; spores 8-13 × 3-4 μ . 28. *F. sclerodermeus*
  3b. Pileus without a thick crust; context usually firm to hard
    5a. Setal hyphae present, conspicuous in the trama . 29. *F. noxius*
    5b. Setal hyphae absent
      6a. Spores cylindrical to oblong-ellipsoid, 5 μ or more long
        7a. Pores 2-4 per mm.; setae 25-55 (-80) μ long ..... 30. *F. viticola*
        7b. Pores 5-8 per mm.; setae 20-32 μ long
          8a. Pileus usually effused-reflexed; context soft-punky; spores 5-6 × 2-2.5 μ; in the western mountains ..... 38. *F. nigrolimitatus*
          8b. Pileus usually ungulate; context firm-fibrous; spores 6-8 × 2.5-3.5 μ; in tropical America 36. *F. cinchonensis*

6b. Spores oblong-ellipsoid to globose
9a. Setae when present usually ventricose, rarely exceeding 20 μ in length, often rare or lacking
10a. Context bright yellowish-brown; spores often up to 8 μ in diameter; basidia 9-11 μ in diameter
39. *F. robustus*
10b. Context dull yellowish- or reddish-brown; spores up to 6 μ in diameter; basidia not over 8 μ in diameter
11a. Spores 2-4 μ broad; context usually soft
12a. Setae present; associated with a conspicuous pocket rot of the wood of coniferous trees in the Pacific Northwest ..... 37. *F. repandus*
12b. Setae absent; known only from tropical America ..... 26. *F. subflexibilis*
11b. Spores 4-5 μ broad; context firm to hard
13a. On a variety of substrata; sporophore often large ..... 40. *F. igniarius*
13b. Restricted to trees bearing stone fruits; sporophore small 41. *F. pomaceus*
9b. Setae usually subulate, usually exceeding 20 μ in length
14a. Some or often most of the setae with curved apices
15a. Setae 25-40 × 6-12 μ; spores 4-6 × 2.5-4.5 μ ..... 43. *F. zealandicus*
15b. Setae 15-30 × 7-16 (-20) μ; spores 5-7 × 4-6.5 μ 44. *F. setulosus*
14b. All of setae with straight apices
16a. Pores 1-4 per mm.
17a. Spores 4-5 μ in diameter; on the wood of coniferous trees, causing a white pocket rot 31. *F. pini*
17b. Spores 5-6 × 4.5-6 μ; on the wood of deciduous trees, associated with a uniform soft white rot . 32. *F. occidentalis*
16b. Pores 4-8 per mm. or smaller
18a. Upper surface strigose, varying to hirsute ..... 42. *F. sarcitus*
18b. Upper surface tomentose or glabrous
19a. Spores 4-5 μ wide; hyphae 2-3 μ in diameter ..... 33. *F. conchatus*
19b. Spores 2-3 μ wide; hyphae usually 3-5 μ in diameter
20a. Spores ellipsoid, 4.5-5 × 2.5-3 μ; pores 5 per mm. ..... 34. *F. taxodii*
20b. Spores broadly oval, 3.5-4 × 2-3 μ; pores 6-10 per mm. ..... 35. *F. roseocinereus*

I. *Context at least in part dark purple-brown*

24. Fomes melanoporus (Mont.) Cooke

FIG. 24

Grevillea 14:20. 1885. *Polyporus melanoporus* Mont. in de la Sagra, Plant. Cell. Cuba, p. 422. 1842. (PC, BPI). *Polyporus melanoporoides* Cesati, Myc. Born., p. 6. 1879 (NY-isotype). *Polyporus cornubovis* Cooke, Grevillea 13:2. 1884 (NY-isotype).

Sporophore solitary or rarely somewhat imbricate, effused-reflexed to sessile, hard, rather light to quite heavy in weight; pileus applanate to convex or subungulate, up to 20 × 30 × 8 cm., the upper surface dark purplish-brown, at first densely tomentose, becoming glabrous, incrusted in age, sulcate, sometimes faintly and narrowly zonate, the margin acute to obtuse; pore surface dark purple-brown, the pores subcircular to angular, 6-8 per mm., edges thin, entire. Context dark purplish-brown, hard, up to 6 cm. thick; tubes distinctly or indistinctly stratified, white-stuffed in older layers, rather brittle, up to 10 mm. long in each layer.

Context hyphae rarely branched, thin- to thick-walled or appearing solid, with frequent but inconspicuous cross walls, 3-7 μ in diameter, the tramal hyphae similar except more slender, 3-4 μ in diameter; hymenial layer 10-12 μ thick; setae not seen, "scanty, ventricose, with expanded bases, up to 40 × 5-10 μ, fuscous" (Cunningham); basidia short-clavate, about 12 × 8 μ; spores hyaline, smooth, oblong-ellipsoid to ellipsoid,

FIGS. 24a and 25a. — Habit, respectively, of top and sectional view of *F. melanoporus* (type) and of *F. lividus* (Murrill 36, at NY), all × 1. FIGS. 24b and 25b. — Context hyphae and spores, in 24b hyphae from type, spores from a collection by Peck, British Honduras in 1908 (NY), in 25b hyphae from type, spores from Murrill 36 (NY).

4-5 × 2.5-3 μ, or "-3.5" (Bresadola), "obovate, subglobose or globose, 3.5-5 × 3.5-4 μ, . . . light fuscous" (Cunningham).

On wood, presumably of angiosperms, from Florida, British Honduras, Nicaragua, Panama, Jamaica, Cuba, Haiti, and Trinidad; throughout the tropical areas of the world.

The fungus is reported to cause a laminated heartwood rot of *Shorea robusta*, see Padwick, Int. Bul. Plant Prot. 13(11):256-258. 1939 (reviewed in Rev. Appl. Mycol. 19:134. 1940).

The uniformly dark color of the entire sporophore is the distinguishing characteristic of the species. *Poria nigra* (Berk.) Cooke closely resembles it except in being resupinate and in having somewhat larger pores, 4-7 per mm. Paler, more or less resupinate forms grade into *F. lividus* which differs as well in having larger pores, 4-6 per mm., and perhaps by larger spores, 5-7 × 3.5-5 μ.

25. Fomes lividus (Kalchbr.) Sacc. FIG. 25

Syll. Fung. 6:206. 1888. *Polyporus lividus* Kalchbr., Grevillea 10:103. 1882 (BPI-isotype). *Fomitiporia cubensis* Murr., N. Amer. Flora 9:8. 1907 (NY, BPI, FH). *Poria cinereo-umbrina* P. Henn., in Voeltzkow, Reise in Ostafrika III, p. 19. 1908 (S and BPI-isotypes). *Fomes cinereus* Torrend in Lloyd, Myc. Writ. 5, Letter 65:9. 1917 (BPI). *Fomes olivaceus* Lloyd, Myc. Writ. 5, Letter 65:14. 1917 (BPI). *Fomes longinquus* Lloyd, Myc. Writ. 7:1335. 1925 (BPI).

Sporophore resupinate or rarely slightly reflexed, more or less corky, sometimes widely effused; on vertical surfaces the marginal and non-pore areas usually blackened and more or less resinous-appearing, rarely reflexed up to 1 cm. and pileus scarcely more than the successive reflexed margins, above blackened, glabrous, minutely cracked; pore surface sordid cream or grayish to pale brownish, the pores round to angular, 4-6 per mm., the edges thick to rather thin, entire. Context pale brown or in part varying to dark purple-brown, more or less fibrous, up to 2 mm. thick; tubes indistinctly stratified, corky-fragile, up to 8 mm. thick in a layer.

Context hyphae usually rather thick-walled, nonseptate, 3-6 μ in diameter, the tramal hyphae apparently somewhat gelatinizing in KOH, 4-6 μ in diam.; setae or cystidia none; spores hyaline, smooth, ellipsoid to oblong-oval, one or sometimes both ends more or less truncate, 5-7 × 3.5-5 μ.

On wood, presumably of angiosperms, in Texas, Honduras, Jamaica, and Cuba; apparently widely distributed in the tropics. The rot is unknown.

The sporophore has the appearance of a pale form of *F. melanoporus*, which differs in its much darker color and in its sessile growth habit, and pores 6-8 per mm. *F. pallidus* Petch, the type of which is sterile, is very similar and may be synonymous. *F. fasciculatus* Burt is in this complex

of species, but appears to differ from *F. lividus* in its strikingly glaucous pore surface and smaller pores, 6-8 per mm. *F. unitus* has similar truncate spores and sometimes darkened context but has much more slender context hyphae, 1.5-3 μ in diameter. Others with truncate spores as *F. ohiensis* and *F. turbinatus* (Pat.) Murr., have much larger spores.

II. *Context pale brown; spores minute, very numerous*

26. Fomes subflexibilis (Berk. & Curt.) Cooke FIG. 26

Grevillea 14:18. 1885. *Polyporus subflexibilis* Berk. & Curt., Linn. Soc. Bot. Jour. 10:311. 1868 (K, BPI, NY).

Sporophore sessile, firm, very light in weight; pileus convex, up to 4 × 5 × 2 cm., the upper surface dark reddish-brown, sometimes with a grayish caste, glabrous, smooth or shallowly sulcate, with a thin crust, the margin rounded; pore surface pale reddish-brown, the pores rounded to somewhat angular, averaging 8-10 per mm., edges becoming thin, entire. Context pale reddish-brown, soft, feltlike, up to 5 mm. thick; tubes indistinctly stratified, sometimes with a thin black line between the layers, papery, up to 7 mm. long in each layer.

Context hyphae rarely branched, mostly thick-walled, nonseptate, 2-3(-4) μ in diameter, the tramal hyphae similar; setae none; spores in large numbers along the hymenium, colorless or with a pale tint of brown, smooth, oblong-ellipsoid, 3.5-4.5 × 2-2.5 μ.

On wood, presumably of angiosperms, from Cuba, Panama, Costa Rica, and St. Vincent Is. The rot is unknown. The extremely light weight, soft-felty context, and abundant spores distinguish the species.

Fomes subflexibilis seems to belong to a group of species characterized by soft-felty context, usually small pores 7-11 per mm., and small spores often found in great abundance along the hymenium. Most of these species have a pale context, as *F. fuscopallens* Bres., *F. intertextus* Lloyd, and *F. roseotubulis* Lloyd, to which may be added tentatively the following whose type specimens are sterile: *F. exotephrus* (Berk.) Cooke, *F. oblinitus* (Berk.) Cooke, and *F. scleromyces* (Berk.) Cooke (the last with larger pores, 4-5 per mm.). *F. agglutinatus* Lloyd, *F. calignosus* (Berk.) Cooke and *F. calignosus* sense of Cesati, and *F. malvenus* Lloyd have a much darker context. According to Bresadola, in published and herbarium notes, *F. cesatianus* P. Henn. appears to be in this group as well. The interrelations of these species are not yet certain. *F. subflexibilis* is very similar to *F. calignosus* (Berk.) Cooke which differs in having a markedly fibrous context with hyphae 4-7 μ in diameter.

III. *Context yellowish- or reddish-brown*

A. *Context composed of a thick horny layer enclosing a relatively soft inner tissue*

27. Fomes fomentarius (L. ex Fries) Kickx — Fig. 27

Flore Crypt. Flandres 2:237. 1867. *Boletus fomentarius* L., Sp. Plant., Vol. 2, p. 1176. 1753. *Polyporus fomentarius* Fries, Syst. Myc. 1:374. 1821. *Polyporus fomentarius* var. *excavatus* Berk., Ann. Nat. Hist. 3:387. 1839 (K).

Sporophore sessile, woody; pileus convex to ungulate, up to 10 × 15 × 10 cm.; surface grayish to brown or grayish-black, glabrous, sulcate, with a thick horny crust, the margin thick and obtuse; pore surface grayish to brown, the pores round, averaging 3 per mm., edges thick, entire. Context rather bright yellowish- or reddish-brown, soft and punky, indistinctly zonate, up to 3 cm. thick, covered with a crust that is black and shiny in section and up to 2 mm. thick; tubes indistinctly stratified, soft and papery, up to 2.5 cm. long in each layer.

Context hyphae rarely branched, thick-walled, 5-10 μ in diameter; tramal hyphae similar except usually more slender, mostly 4-5 μ in diameter but up to 8 μ, often minutely incrusted; setae none; spores hyaline, smooth, cylindric-ellipsoid, 17-20 × 5-6 μ.

On dead or rarely on living hardwoods from Newfoundland south to Tennessee, westward to the prairies, and in the northern Rocky Mountains northward to Alaska.

The fungus is the cause of a white mottled rot of heartwood and sapwood of angiosperms, see Buchwald, Medd. Foren. Svampekundsk. Fremme, pp. 49-92. 1930; Hilborn, Maine Agr. Exp. Sta. Bul. 409, pp. 161-214. 1942 (biology); Cartwright and Findlay, 1950, p. 102; Macdonald, Edinburg Bot. Soc. Trans. & Proc. 32, pt. 3:396-408. 1938, and von Schrenk and Spaulding, U. S. Dept. Agr. Bur. Plant Ind. Bul. 149:50-51. 1909.

28. Fomes sclerodermeus (Lév.) Cooke — Fig. 28

Grevillea 14:18. 1885. *Polyporus sclerodermeus* Lév., Ann. Sci. Nat. Bot. 3, 5:129. 1846 (PC). *Polyporus marmoratus* Berk. & Curt., Amer. Acad. Arts and Sci. [Boston] Proc. 4:122. 1860 (K, FH). *Fomes subfomentarius* Romell, Svenska Vet.-Akad. Handl. Bih. 26, 3(16):19. 1901 (S). *Elfvingia fasciata* in sense of Murrill in Torrey Bot. Club Bul. 30:298. 1903, perhaps *Polyporus fasciatus* Swartz ex Fries, Syst. Myc. 1:373. 1821.

Sporophore sessile, woody; pileus convex to ungulate, up to 15 × 25 × 15 cm., the upper surface grayish or darkening, glabrous, smooth, sometimes faintly zonate and shallowly sulcate, with a thick horny crust, the margin obtuse; pore surface grayish brown, the pores round, averaging 4-6 per mm., edges thick, entire. Context reddish-brown, soft-fibrous, faintly zonate, up to 5 cm. thick, with a crust which is brownish-black

and shining in section and up to about 1 mm. thick; tubes indistinctly stratified, firm-corky, up to about 5 mm. long in each layer.

Context hyphae long-flexuous, rarely branched, thick-walled, nonseptate, 5-10 μ in diameter, the tramal hyphae similar except somewhat more slender, 3-7 μ in diameter; cystidioles occasional, about 17-19 $\times$ 6-8 μ; basidia clavate, 17-19 $\times$ 8-11 μ; spores hyaline, smooth, oblong to subfusiform, 8-13 $\times$ 3-4 μ, or "10-12 $\times$ 5-6 μ" (Lloyd).

On dead or living angiosperm trees in North Carolina southward and westward to Texas; widespread in the tropics. The fungus is associated with a white rot. This species is very similar to *F. fomentarius* except that the latter has larger pores, 3 per mm., and apparently larger spores, 17-20 $\times$ 5-6 μ. Spores of *F. sclerodermeus* are inadequately known, as specimens are almost invariably sterile.

The identity of *Polyporus fasciatus* is quite uncertain, and therefore a later, certain name is used here for this species.

FIGS. 26a, 27a, 28a. — Habit, respectively, of *Fomes subflexibilis* $\times$ $\frac{2}{3}$ (type), of *F. fomentarius* (about $\times$ $\frac{1}{8}$), and top and sectional view of *F. sclerodermeus* $\times$ $\frac{2}{3}$ (type). FIGS. 26b, 27b, 28b. — Context hyphae and spores from the same, except spores of 27b from Lowe 5402, and spores of 28b from Lloyd Herb. 6571 (BPI).

AA. *Context homogeneous or externally more or less indurated*
a. *Setal hyphae present*

29. Fomes noxius Corner — FIG. 29

Gardens' Bul. Straits Settlement 5:342. 1932 (BPI and NY-isotypes).

Sporophore usually solitary, decurrent on the substratum or more commonly sessile, drying rigid, of rather light weight; pileus livid reddish-brown to blackish, glabrous, sometimes faintly and narrowly zonate, convex, up to 6 $\times$ 12 $\times$ 4 cm., the margin concolorous, rounded; pore surface grayish-brown or pale brown, the pores subangular, (5-) 7-9

per mm., dissepiments thin, entire. Context shining golden brown, rather soft, distinctly and narrowly zonate, radially fibrous, usually with a darker indurated thin area forming the upper surface, up to 8 mm. thick; tubes in one layer so far as seen, darker than the context, rigid and brittle when dry, up to 4 mm. long in one layer.

Context hyphae bright red but without stain in KOH, compactly arranged, of two kinds, mostly thin-walled, septate, 4-8 μ in diam., in strictly parallel arrangement, and with a variable mixture of thick-walled setal hyphae 8-11 μ in diam.; tramal hyphae thick-walled, apparently strongly agglutinated, about 3-4 μ in diam.; setae absent or very rare, subulate, about 25 $\times$ 7 μ; setal hyphae abundant, diverging outward from the trama at a rather slight angle, blunt at the tip, 8-13 μ in diam.; spores according to Corner hyaline, broadly ellipsoid, 3.5-4.5 $\times$ 3-3.5 μ; spores of uncertain origin along the hymenium of type material hyaline, smooth, variable in shape, oblong-ellipsoid to oval, 3.5-5 $\times$ 2.5-3.5 μ.

Presumably on wood in Costa Rica, Cuba, and Puerto Rico; elsewhere known from the East Indies, India, and Africa.

The fungus is reported to be a facultative parasite causing a serious stem and root rot of rubber, oil palm and other economic plants. Its distribution is given in the Imperial Mycological Institute map no. 104 (1947), where, in addition, numerous abstracts in the Review of Applied Mycology are cited concerning its pathological importance.

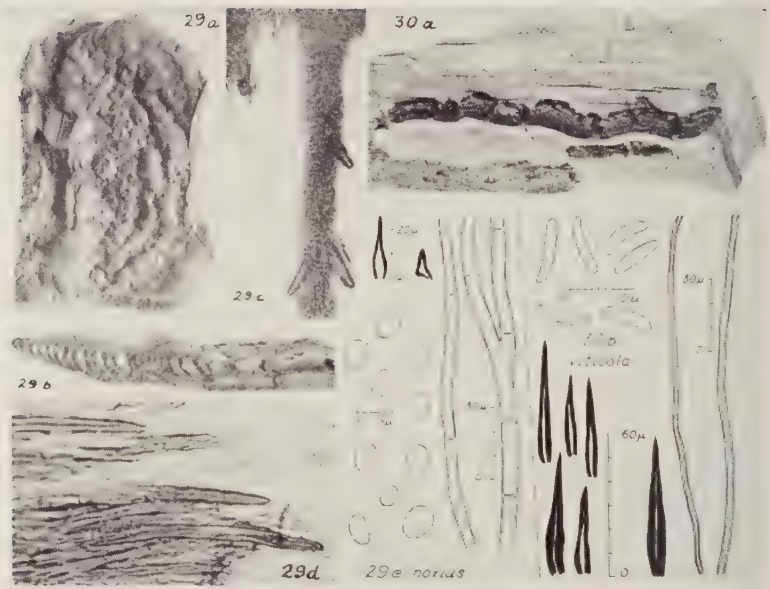
The fungus is sometimes considered a synonym of *F. lamaensis* (Murr.) Sacc. & Cub. but that species differs in having a faintly zonate context with intertwined thin-walled hyphae 2.5-4 μ in diameter, more slender setal hyphae, mostly 5-6 μ in diameter, usually abundant setae, and, according to Corner, a strictly saprophytic habit. *F. pachyphloeus* (Pat.) Bres. has setal hyphae but forms massive sporophores, has a darker felt-like context under a hard crust, and setae. *F. portoricensis* differs in having pale, soon distinctly reddish-brown spores.

aa. *Setal hyphae absent; setae subulate or subventricose*
b. *Setae usually 30 μ or more long*

30. Fomes viticola (Schw.) Lowe, comb. nov. FIG. 30

Polyporus viticola Schw. in Fries, Elenchus 1:115. 1828 (PH, BPI). *Boletus superficialis* Schw., Naturf. Gesell. Leipzig Schr. 1:99. 1822 (PH, BPI). *Polyporus viticola* Schw. β *superficialis* Schw. ex Fries, Elenchus 1:115. 1828. *Trametes isabellina* Fries, Hym. Eur., p. 585. 1874 (UPS). *Fomes tenuis* Karst. in Roumeguére Fungi Gall. Exs. No. 4019. 1887 (H, BPI). *Trametes setosus* Weir, Jour. Agr. Res. 2:164. 1914 (BPI).

Sporophore resupinate and widely effused, or effused-reflexed to sessile, leathery to woody; pileus conchate to applanate or convex, up to 1.5 $\times$ 10 $\times$ 1.3 cm., the upper surface reddish-brown, in age weathering to



FIGS. 29a and b, and 30a. — Habit, respectively, of upper surface of type material of *Fomes noxius* (× ½), a vertical section showing the prominent zonation lines (× 1), and of *F. viticola* × ½ (Lowe 6852). FIG. 29c. — Vertical section of the tubes showing the setal hyphae projecting from the trama, × 120. FIG. 29d. — Setal hyphae in the context, × 200. FIGS. 29e and 30b. — Context hyphae, setae, and spores from the same specimens.

grayish-black, velvety tomentose or in age becoming more or less glabrous, sulcate, the margin usually lighter colored; pore surface cinnamon-brown to yellowish-brown, the pores round to elongated and somewhat sinuous, averaging 2-4 per mm., edges moderately thick to thin, entire. Context yellowish- or reddish-brown, rather soft-fibrous, up to 1 mm. thick; tubes indistinctly stratified, usually grayish within, up to 5 mm. long in each layer.

Context hyphae rarely branched, rather thin-walled, occasionally septate, 2-3 μ in diameter; tramal hyphae similar except somewhat more slender, 2-2.5 μ in diameter; hymenial layer 10-15 μ thick; setae subulate, 25-55 (-80) × 5-11 μ; basidia narrowly clavate, 12-13 × 3.5-5 μ; spores hyaline, smooth, cylindrical, 5-9 × 1.5-2 μ.

On the wood of gymnosperms and angiosperms throughout the United States and southern Canada, in Europe and New Zealand. The fungus is associated with a ring rot and a white pin rot, see Weir, Jour. Agr. Res. 2:164. 1914. *F. nigrolimitatus* is most similar to this but has pores 5-6 per mm., setae 25-32 μ long, and spores 5-6 × 2-2.5 μ. Tropical resupinate material should be compared with *Poria cryptacantha* (Mont.) Cooke, which may differ by having ellipsoid spores 6-7 × 3 μ. The type of

P. cryptacantha is sterile, as is nearly all material seen, and this spore difference cannot be considered as established with certainty. *Poria palmicola* (Berk. & Curt.) Cooke is also similar, but appears to have a much softer sporophore. Tropical pileate material should be compared with *Fomes cereus* (Berk.) Bres., which is inadequately known, but may differ in having a more fragile sporophore.

The type material of *Boletus superficialis* was described earlier than *P. viticola.* It is sterile, but is certainly the same as *P. viticola.* According to the present rules of nomenclature, *B. superficialis,* although published first, is superseded by *P. viticola* and so cannot serve as the nomenclatural type of the species.

31. Fomes pini (Thore ex Pers.) Lloyd — Fig. 31

Mycological Writings 4:275. 1915. *Boletus pini* Thore, Ess. Chloris Dept. Landes, p. 487. 1803. *Polyporus pini* Thore ex Pers., Myc. Eur. 2:83. 1825. *Daedalea vorax* Harkness, Pacific Rural Press 17(4):49. 1879. (FH-lectotype). *Fomes abietis* Karst., Bidr. Finl. Nat. Folk 37:242. 1882 (H, BPI). *Polyporus piceinus* Peck, N. Y. S. Ann. Rept. 42:25. 1889 (NYS, BPI, NY). *Cryptoderma yamanoi* Imazeki, Forsch. Geb. Pflanzenkrankh. 4:176. 1951 (BPI-isotype).

Sporophore solitary or imbricate, resupinate to effused-reflexed or sessile, firm to woody; pileus thin and conchate in the annual form, becoming ungulate in the perennial form, up to 15 × 20 × 15 cm., the upper surface at first yellowish-brown to reddish-brown, becoming grayish-black or brownish-black toward the base or in the ungulate form becoming blackish, glabrous, cracking and becoming rough, when young with elevated zones of appressed tomentum; margin obtuse to acute; pore surface yellowish-brown to reddish-brown, the pores angular to sinuous or daedaloid, usually 3-4 per mm. or in the ungulate form 1-3 per mm., edges thin, entire. Context yellowish-brown to reddish-brown, woody, up to 5 mm. thick, with a thin dark line separating tomentum and context; tubes becoming indistinctly stratified, firm, corky to rigid, up to 6 mm. long in a layer.

Context hyphae rarely branched, thin- to rather thick-walled, occasionally septate, 3-5 μ in diameter, the tramal hyphae similar; hymenial layer about 13 μ thick; setae abundant, subulate, 33-45 × 7-11 μ; basidia nearly cylindrical, 11-13 × 5-6 μ; spores hyaline or in age brownish, smooth, subglobose to globose, 4-5 μ.

The authorities for this name depend on which nomenclature rules are followed. A homonym for the same plant was proposed by Broteri in 1804 (Fl. Lusit. 2:468); this name was validated by Fries in 1821 (*Daedalea pini* Brot. ex Fries, Syst. Myc. 1:336); and the genus changed by Karsten in 1882 (Bidr. Finl. Nat. Folk 37:79. 1882). If authorities earlier than Fries are disregarded, the name would be *Fomes pini* (Fries) Karst.

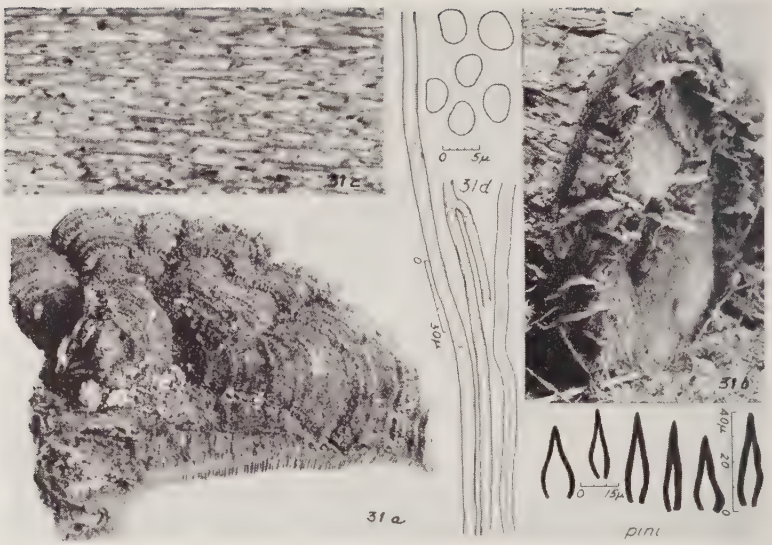


FIG. 31. — *Fomes pini.* FIG. 31a. — Ungulate specimen, from western United States × ½ (specimen in Coll. Forestry Herb.). FIG. 31b. — Conchate specimen, frequent in the eastern U. S., about × ¼ (Lowe 6451). FIG. 31c. — Typical pocket rot caused by *F. pini,* from Lowe 6451 (× 1). FIG. 31d. — Context hyphae, setae, and spores of *F. pini* (from Lowe 6451).

On wood of gymnosperm or rarely and doubtfully of angiosperm trees throughout the United States, Canada and Alaska; elsewhere throughout the North Temperate zone of the world. The morphology of the sporophore is so variable that recognition of varieties does not seem justified.

The fungus is the cause of a very destructive white pocket rot of the wood of gymnosperms, see Abbott, Vermont Agr. Exp. Sta. Bul. 191. 1915; Boyce (1948, pp. 373-380); Cartwright and Findlay, 1950, p. 75; Haddow, Brit. Mycol. Soc. Trans. 22:182-193. 1938, and in Roy. Canad. Inst. Trans. 22, 1:21-80. 1938; Hiley, Fungal Diseases Common Larch, pp. 140-143. 1919; Jorstad and Juul, Medd. Norske Skogforsoksv. B.6, H.3, nr. 22, pp. 362-425, 477-478. 1939; Liese, Forstarchiv 12:37-48. 1936; Owens, Amer. Jour. Bot. 23:144-158, 235-254. 1936; Percival, N. Y. S. Col. Forestry Tech. Publ. 40. 1933 (biology); Spaulding, Important Tree Pests of the Northeast, pp. 135-138. 1952.

32. Fomes occidentalis Overh. FIG. 32

Mycologia 33:101. 1941 (BPI, PAC).

Sporophore resupinate to effused-reflexed or sessile, woody, of rather light weight; pileus convex, up to 2.5 × 6 × 1.5 cm., the upper surface livid to blackish or in age grayish, glabrous, rather smooth, not markedly

cracked or rimose, indistinctly zoned, the margin yellowish-brown or reddish-brown, finely pubescent, usually soon matting and wearing glabrous; pore surface reddish-brown or yellowish-brown, the pores somewhat angular, averaging 3-4 per mm., edges rather thin, entire. Context dark reddish-brown, fibrous, with a thin dark line in the upper half, about 1 mm. thick; tubes very indistinctly stratified, white-lined, firm-corky, up to 5 mm. long in each layer.

Context hyphae brown, rarely branched, moderately thick-walled to rather thick-walled, nonseptate, 3-5 μ in diameter, intermixed with indistinct, paler to hyaline hyphae 2-3 μ in diam.; tramal hyphae similar except 2.5-3 μ in diameter; hymenial layer 10-13 μ thick; setae rare, subulate to somewhat ventricose, 35-50 $\times$ 6-12 μ; basidia clavate, 9-12 $\times$ 5-7 μ; spores hyaline, smooth, subglobose to globose, 5-6 $\times$ 4.5-6 μ.

On angiosperms, on *Crataegus* alone so far as known, in Montana, Idaho, Washington, Oregon, and Utah. The associated rot is uniform and white.

The sporophore of this species intergrades morphologically with that of *F. pini* which, however, occurs only on gymnosperm wood and causes a pocket rot. The fungus also differs in gross cultural characters (R. W. Davidson [letter] and R. L. Gilbertson [letter]). The habit of the plant is similar to that of *F. conchatus* which differs in having smaller pores, 4-7 per mm., shorter setae, 18-30 μ long, and more slender context hyphae, 2-3 μ in diameter.

bb. *Setae rarely as much as 30 μ long*

33. Fomes conchatus (Pers. ex Fries) Gill. FIG. 33

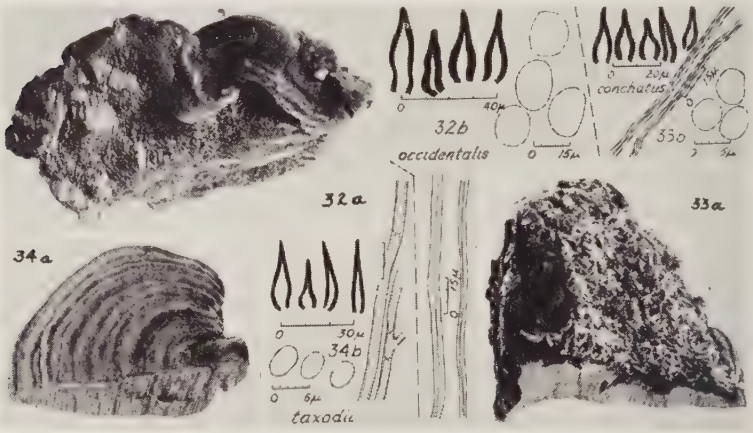
Champ. France, p. 685. 1878. *Boletus conchatus* Pers., Obs. Myc. 1:24. 1796. *Polyporus conchatus* Fries, Syst. Myc. 1:376. 1821. *Fomes densus* Lloyd, Mycol. Writings C. G. Lloyd 4:245. 1915 (BPI-paratypes).

Sporophore often imbricate, effused-reflexed or sessile, woody; pileus thin and conchate to convex, up to 5 $\times$ 10 $\times$ 3 cm., the upper surface grayish-brown or yellowish-brown to black, tomentose, sulcate, not rimose but with age becoming incrusted, often moss-covered; margin acute; pore surface yellowish-brown to dark brown, the pores round, 4-7 per mm., edges rather thick, entire. Context reddish- or yellowish-brown, woody, with one to several black lines, up to 3 mm. thick; tubes indistinctly stratified, firm-corky, up to 3 mm. long in a layer.

Context hyphae rarely branched, thick-walled, nonseptate, 2-3 μ in diameter, the tramal hyphae similar; hymenial layer about 11 μ thick; setae occasional to rare, broadly subulate to ventricose, projecting up to 20 μ beyond the hymenium, 18-30 $\times$ 5-10 μ; basidia clavate, about 10 $\times$ 4-6 μ; spores hyaline, smooth, ovoid to subglobose, 4.5-6 $\times$ 4-5 μ.

On wood of angiosperms, especially ash, from New Brunswick west to Manitoba and Montana, and southward to Florida and Texas. The sporophores resemble those of *F. occidentalis* and the thin form of *F. pini,* both of which have larger pores and longer setae. *F. pini* grows only on gymnosperm wood. *Fomes zealandicus* is very similar externally, but differs microscopically in having hooked setae.

The associated rot is white, mottled with rusty flecks. A similar decay on hardwoods in Pakistan was at first attributed to *F. conchatus* (Pakistan Jour. Forestry 1:148-150, reviewed in Rev. Appl. Mycol. 30:498. 1951). The fungus was later considered unnamed, and was proposed as *Fomes ajazi* Hussain in Mycologia 44:823. 1952. Kew material of *F. ajazi* from the type locality appears to be the same as *F. linteus.*



FIGS. 32a, 33a, and 34a. — Habit, respectively, of *Fomes occidentalis* × 1 (isotype, Overholts Herb. 21572), of *F. conchatus* × ½ (Lowe 3283), and of *F. taxodii* × ½ (Lowe 4046). FIGS. 32b, 33b, 34b. — Spores, setae, and context hyphae from the same.

34. Fomes taxodii Murr. FIG. 34

Torrey Bot. Club Bul. 65:661. 1939. *Pyropolyporus taxodii* Murr., Torrey Bot. Club Bul. 65:651. 1939 (FLAS).

Sporophore sessile, hard and woody, of medium weight; pileus applanate to convex, up to 7 × 10 × 3 cm., the upper surface reddish brown, glabrous, somewhat sulcate, the margin acute; pore surface reddish-brown, the pores round, averaging 5 per mm., edges thick, entire. Context bright reddish-brown, hard, up to 4 mm. thick; tubes distinctly stratified, rather soft-corky, up to 1.5 cm. long in each layer.

Context hyphae rarely branched, thin- or rather thin-walled, occasionally septate, 2.5-5 μ in diameter; tramal hyphae similar except more slender, 2-3 μ in diameter; hymenial layer 8-13 μ thick; setae frequent,

subulate, 20-30 × 5-8 μ; basidia clavate, 11-13 × 5-7 μ; spores hyaline, smooth, ellipsoid, 4.5-5 × 2.5-3 μ.

On cypress in Georgia and Florida. The rot is unknown.

Fomes taxodii is one of a group of numerous and perplexing species represented in the Temperate Zone by *Polyporus gilvus* Fries, in southern Europe and subtropical America by *F. torulosus* (Pers.) Lloyd and its annual form *P. licnoides* Mont., and apparently, by many inadequately known tropical species such as *F. bambusinus* (Pat.) Sacc., *F. fullageri* (Berk.) Cooke, *F. haskarlii* (Lév.) Bres., — Leiden type material, *F. hawaiensis* Lloyd, *F. korthalsii* (Lév.) Cooke, *F. senex* (Nees & Mont.) Cooke, *F. subextensus* (Murr.) Sacc. & Trott., and *F. velutinosus* Lloyd. The type specimens of most of these are sterile and their identity therefore uncertain.

35. Fomes roseocinereus (Murr.) Sacc. & Trott. FIG. 35

Syll. Fung. 21:291. 1912. *Pyropolyporus roseocinereus* Murr., North Amer. Flora 9:104. 1908 (NY, BPI).

Sporophore sessile, woody, of medium weight; pileus convex to ungulate, up to 5 × 8 × 2 cm., the upper surface dark reddish-brown, glabrous, sulcate, the margin rather thin; pore surface yellowish-brown or reddish-brown, sometimes somewhat glaucous, the pores round, 6-10 per mm., edges thick, entire. Context bright yellowish- or reddish-brown, subwoody, sometimes with a dark line gradually formed at the upper surface, up to 2 mm. thick; tubes faintly stratified, subcorky, up to 3 mm. long in a layer.

Context hyphae mostly thick-walled, septate only in the thinner-walled hyphae, 3-5 μ in diameter, the tramal hyphae similar; hymenium 8-10 μ thick; setae usually present, subulate, 20-30 × 4-5 μ; basidia clavate, 8 × 6-8 μ; spores hyaline, smooth, broadly oval, 3.5-4 × 2-3 μ.

On wood, presumably of angiosperms, known from the type in Cuba and from Costa Rica (nonsetulose, Maxon 491, N.Y.). The rot is unknown. The sporophore resembles those of *F. conchatus,* but that has more slender context hyphae and larger spores. Externally this species resembles *F. glaucoporus* Lloyd, which has a similar glaucous pore surface, but in that species the context hyphae are 2-3 μ in diameter, setae are lacking, and the spores are more nearly globose and somewhat larger, 4-5 × 4-4.5 μ. Smooth forms of *F. robustus* also resemble *F. roseocinereus,* but lack setae and have larger spores.

36. Fomes cinchonensis (Murr.) Sacc. & Trott. FIG. 36

Syll. Fung. 21:286. 1912. *Pyropolyporus cinchonensis* Murr., Mycologia 2:195. 1910 (NY, BPI).

Sporophore sessile, light in weight; pileus more or less ungulate, up to 7 × 15 × 9 cm., the upper surface lurid reddish-brown, soon glabrous, quite smooth, sometimes coarsely sulcate, the margin similar or occasionally obtuse and velvety; pore surface yellowish-brown, the pores round, about 5-6 (-8) per mm. Context silky, intensely reddish-brown, faintly zonate, firm-fibrous, up to 2 cm. thick; tubes in indistinct layers, rather soft-papery, up to 7 mm. long in a layer.

Context hyphae thin- to thick-walled, nonseptate, 3-6 μ in diameter, the tramal hyphae similar; setae usually frequent, subulate, 20-30 × 4-8 μ; spores hyaline, smooth, cylindrical to oblong-ellipsoid, 6-8 × 2.5-3.5 μ.

On wood, presumably of angiosperms, in Panama and Jamaica. The rot is unknown. The characteristics of this plant, both external and internal, resemble those of smooth forms of *F. robustus,* but the presence of setae and the usually cylindrical spores readily separate it.

FIGS. 35a, 36a, 37a. — Habit, respectively, of *Fomes roseocinereus* × 1 (type), of half of *F. cinchonensis* × ½ (type), and of *F. repandus* × 1 (type). FIGS. 35b, 36b, 37b. — Spores, setae, and context hyphae from the same, except 36b, spores from paratype, Murrill 446.

aaa. *Setal hyphae absent; setae subventricose to ventricose, in some species often rare or absent*

c. *Setae straight at the tips*

d. *Context soft and punky*

37. Fomes repandus Overh. FIG. 37

Mycologia 44:224. 1952 (PAC).

Sporophore resupinate or broadly effused-reflexed, woody; pileus narrowly reflexed, convex, up to 3 × 10 × 4 cm., the upper surface at first reddish-brown, soon black, glabrous, rough, sulcate, becoming hardened, the margin yellowish-brown, soon blackening, rounded; pore surface smoky brown to dark brown, the pores round, averaging 5-7 per mm., edges thick, entire. Context reddish-brown, soft and fibrous to fibrous-fragile, up to 0.5 cm. thick, with black lines through it; tubes indistinctly stratified, hard, fragile, up to 5 mm. long in each layer, with total thickness of up to 2.5 cm.

Context hyphae rarely branched, thick-walled, inconspicuously septate, 3-5 μ in diameter; tramal hyphae similar except nonseptate; hymenium 8-13 μ thick; setae rare, short and blunt or narrowly conical, 13-24 × 7-10 μ, projecting up to 20 μ; basidia 8-11 × 5-8 μ; spores hyaline, smooth, ellipsoid to subglobose, 3.5-5 × 2.5-4 μ.

On dead wood of gymnosperms in Mont., Idaho, Ore., Wash., and British Columbia. The fungus is associated with a striking white pocket rot. Both the sporophore and the rot suggest *F. nigrolimitatus* which has, in contrast, longer setae, 25-32 μ long, and cylindrical spores.

38. Fomes nigrolimitatus (Rom.) Egeland FIG. 38

Nyt Mag. Naturv. 51:76. 1913. *Polyporus nigrolimitatus* Rom., Arkiv f. Bot. 11, 3:18. 1912 (S). *Fomes putearius* Weir, Jour. Agr. Res. 2:163. 1914 (BPI).

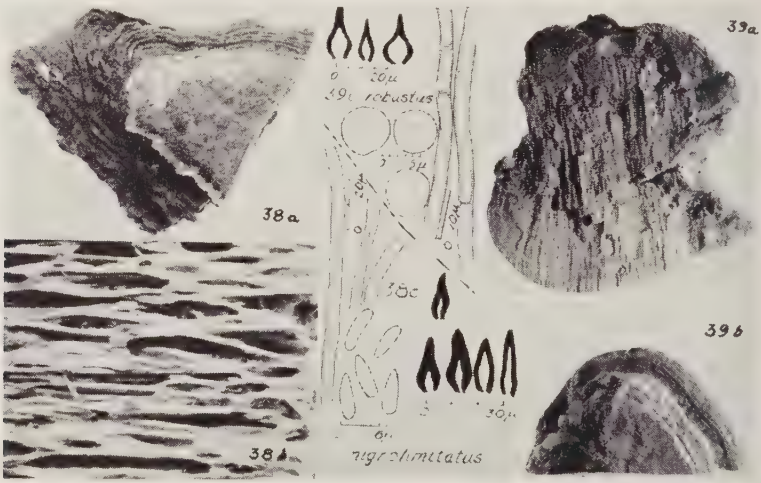
Sporophore resupinate, very often with receding margins in successive layers of growth, effused-reflexed or sessile, "soft, corky and flexible when fresh" (Overholts), rigid when dry, widely effused when resupinate or the pileus applanate to convex, up to 6 × 20 or more × 5 cm., the surface brown to blackish, soft-tomentose or weathering to dark reddish-brown and glabrous, sometimes somewhat sulcate, the margin acute to more often obtuse; pore surface pale tawny or brownish to dark brown, or grayish, the pores rounded to subangular, about 5-6 per mm., edges rather thin, entire; tubes indistinctly stratified, up to 8 mm. long in each layer. Context bright reddish-brown to dark brown, soft-punky when dry, up to 3 cm. thick, with a rather distinct black line separating the context from the tramal area, such black lines also irregularly placed elsewhere in the context.

Context hyphae rarely branched, becoming rather thick-walled, with inconspicuous and rare cross walls, 2.5-4 μ in diameter, the tramal hyphae similar but more slender, 2.5-3 μ in diameter; hymenium about 10-15 μ thick; setae frequent to abundant, broadly subulate to more or less ventricose, about 25-32 × 6-11 μ; basidia clavate, about 10-13 × 5-8 μ;

spores hyaline, smooth, cylindrical or somewhat attenuated at the distal end, 5-6 × 2-2.5 μ.

On the wood of gymnosperms from Colorado and California northward to British Columbia and Alaska; in Europe and New Zealand. The sporophore is very similar to that of *F. repandus* which has, however, shorter setae 13-24 μ long, and ellipsoid to subglobose spores. Resupinate specimens externally resemble *Poria weirii* Murr. and *P. ferrugineofusca* Karst., which differ most distinctly in having setal hyphae, and *Fomes viticola,* which has larger pores, 2-4 per mm., more slender and longer setae, up to 80 μ long, and more slender spores, 5-9 × 1.5-2 μ.

The fungus is associated with a conspicuous white pocket rot, see Buckland, Canad. Jour. Res. C., 24:165: 1946; Lohwag, Int. Holzmarkt (Holzforschung, Ser. 3), pp. 22-24. 1950, reviewed in Rev. Appl. Mycol. 32:111. 1953; and Weir, Jour. Agr. Res. 2:163. 1914.



FIGS. 38a and b. — *Fomes nigrolimitatus* showing, respectively, the receding type of the tube growth (× ½) and the conspicuous pocket rot (× 1) caused by this species, both from Forest Path. No. 94074. FIGS. 39a and b. — *F. robustus* showing, respectively, a vertical section of a specimen from Sweden in the College of Forstry Herbarium × ¼, and b, upper surface of smooth form found in warm areas, this the type of *Pyropolyporus crustosus* × ½. FIGS. 38c and 39c. — Setae, spores, and context hyphae of the same species, 38c from specimen in College of Forestry Herbarium, Gilbertson 370; 39c, setae and context hyphae from the type material, the spores from the Swedish specimen.

dd. *Context firm to woody*

39. Fomes robustus Karst. FIG. 39

Bidrag känn. Finl. Nat. Folk 48:467. 1889 (H, BPI, NY). *Polyporus hartigii* Allescher & Schnabl, Fung. Bavar. Exs., Cent. I, No. 48. 1890

(NY). *Pyropolyporus calkinsii* Murr., Torrey Bot. Club Bul. 30:113. 1903 (NY-lectotype, BPI). *P. crustosus* Murr., same, p. 113 (NY). *P. haematoxyli* Murr., same, p. 117 (NY, BPI). *P. bakeri* Murr., North Amer. Flora 9:104. 1908 (NY, BPI). *P. texanus* Murr., same, p. 104 (NY, BPI). *P. abramsianus* Murr., Western Polypores, p. 26. 1915 (NY, BPI).

Sporophore resupinate to effused-reflexed or sessile, woody; pileus when reflexed convex to ungulate, up to 8 × 15 × 5 cm., the upper surface of the pileus gray to grayish-black or black, glabrous, sulcate, smooth or cracking somewhat with age but rarely rimose, sometimes indurated, the margin sometimes thick, with a broad rusty red band, behind brown or grayish-brown changing to blackish; pore surface brown, the pores round, 4-6 (-8) per mm., edges thick, entire. Context bright yellowish-brown, shining, corky to woody, sometimes fibrous, zonate, up to 2.5 cm. thick; tubes distinctly to indistinctly stratified, more or less white-incrusted or stuffed in the older layers, up to 7 mm. long in a layer.

Context hyphae rarely branched, thin- to thick-walled, occasionally to frequently septate, 3-7 μ in diameter; tramal hyphae similar except more slender, 2-4 μ in diameter; hymenium 11-13 μ thick; basidia broadly clavate, 11-13 × 9-11 μ; setae usually none, when present rare, ventricose, 16-19 × 7-9 μ; spores hyaline, smooth, subglobose, often apiculate, 4-8 μ in diameter.

On angiosperms or occasionally on gymnosperms throughout the United States, in Quebec, British Columbia, and Alaska, and in tropical America; apparently nearly worldwide in distribution.

The bright yellow-brown context, usual absence of setae, and hyaline, globose spores mostly 5-8 μ in diameter identify the species. It is an extremely variable one, as is attested by the synonyms of pileate species and the 12 synonyms of the resupinate condition enumerated below. The category of these species depends somewhat on the taxonomic philosophy assumed. *Pyropolyporus calkinsii,* and *"Fomes hartigii"* as named from the Pacific Coast states, characteristically have an ungulate shape, context hyphae about 2-5 μ in diameter, and spores 5-6 μ in diameter. In *Pyropolyporus texanus* and *P. haematoxyli* the older pileus surface often may be deeply fissured. Transitional stages of these characteristics can be found in ample material, and European material of *F. robustus* and *F. hartigii* likewise show these variations. The type of *P. haematoxyli* has spores quite small for this species, 4-5 × 3.5-4.5 μ and is somewhat doubtfully included as a synonym; it somewhat resembles *F. roseocinereus* but lacks setae. Other probable synonyms are *F. rhaponticus* Lloyd (with rare setae; spores probably hyaline, 6 μ in diameter — Lloyd's record of "10 × 12, colored" surely in error), *F. testaceo-fuscus* Bres. (the context darker than is typical), and *F. yasudai* Lloyd (spores unknown). *F. baccharidis* (Pat.) Lloyd has similar spores, but forms a small pileus and has smaller pores, 9-10 per mm., and nonseptate context hyphae.

The following are considered to be resupinate conditions of this species: *Poria punctata* (Fries) Karst., at least in the sense of American authors; the following species described by Murrill: *Fomitiporia dryophila, F. earleae, F. jamaicensis, F. laminata, F. langloisii, F. lloydii, F. maxoni, F. obliquiformis, F. tsugina; Fuscoporia juniperina;* and *Fomes robustus taxodii* Baxter, according to his description.

The fungus is the cause of a white heartrot, see Lohwag, Ann. Mycol. 35:339-349. 1937 and in Zeitschr. Pflanzenkrankh. u. Pflanzensch. 50:481-494. 1940; and Davidson and Mielke, Mycologia 39:210-217. 1947.

40. Fomes igniarius (L. ex Fries) Kickx FIG. 40

Flore Crypt. Flandres, Vol. 2, p. 237. 1867. *Boletus igniarius* L., Sp. Plant., Vol. 2, p. 1176. 1753. *Polyporus igniarius* L. ex Fries, Syst. Myc. 1:375. 1821. *Fomes nigricans* (Fries) Cooke, of American authors at least. *Fomes nigricans* var. *populinus* Neuman, Polyp. Wisconsin, p. 81. 1914. *Fomes borealis* Lloyd, Myc. Writ. C.G. Lloyd 4:247. 1915 (BPI). *Fomes arctostaphyli* Long, N. Mex. Chap. Phi Kappi Phi Papers 1:2 1917 (BPI, NY).

Sporophore usually solitary, sometimes somewhat imbricate, usually sessile, but also resupinate to narrowly reflexed, woody; pileus plane to convex or ungulate, up to 10 × 20 × 11 cm., the upper surface grayish-black to black, sometimes shiny, becoming glabrous, at first smooth, becoming more or less rimose and incrusted with age, the margin obtuse, sometimes very thick and yellowish-brown; pore surface brown, the pores round, averaging 4-5 per mm. in pileate forms, smaller, to 8-10 per mm. in resupinate forms, edges rather thick, entire; context dark reddish-brown, woody, up to 1 cm. thick; tubes usually indistinctly stratified, the older layers conspicuously white-stuffed, up to 5 mm. long in a layer.

Context hyphae rarely branched, nonseptate, thick-walled, 3-5 μ in diameter; tramal hyphae similar except 2-3 μ in diameter; hymenial layer 10-13 μ thick; setae usually abundant, sometimes rare to apparently absent, ventricose, 11-14 × 5-8 μ, projecting up to 8 μ beyond the hymenium and often almost wholly imbedded; basidia clavate, 9-11 × 6-7.5 μ; spores hyaline, smooth, ovoid to subglobose, 4-6 × 4-5 μ.

On the wood of living angiosperms or on fallen logs throughout the United States, Canada, and Alaska; throughout the North Temperate zone. The sporophore is extremely variable in shape. The specific concept here is a broad one, embracing resupinate sporophores as well as the ungulate form. Cultural work has shown differences between them but there appear to be no constant morphological differences.

The following are considered to be resupinate conditions of this species: *Poria laevigata* (Fries) Karst., *Fomitiporella betulina* Murr., *Fomitiporia pereffusa* Murr., and *F. prunicola* Murr.

The fungus is the cause of a destructive soft white heartrot, see Boyce (1948, pp. 394-397); Campbell and Davidson, Jour. Forestry 39:559-560. 1941; Cartwright and Findlay, 1950, p. 106; Horton and Hendee, Jour. Forestry 32:493-494. 1934; Meinecke, U. S. Dept. Agr. Tech. Bul. 155. 1929; Riley, Canad. Jour. Bot. 30:710-734. 1952; Schmitz and Jackson, Univ. Minnesota Agr. Exp. Sta. Tech. Bul. 50. 1927; Spaulding, Important Tree Pests of the Northeast, pp. 133-135. 1952; von Schrenk and Spaulding, U. S. Dept. Agr. Bur. Plant Ind. Bul. 149:25-37 and 42-44. 1909; and Vanine (see Rev. Appl. Mycol. 8:411-412. 1929).

FIGS. 40a and 41a. — Habit, respectively, of *Fomes igniarius* on hornbeam × $\frac{1}{7}$, and of *F. pomaceus* × 1, Forest Pathology No. 19126 (at BPI). FIGS. 40b and 41b. — Context hyphae, setae, and spores of the same species, 40b from specimen without data in the College of Forestry Herbarium; 41b from a collection by W. A. Campbell in S. Carolina (Col. Forestry Herb.).

41. Fomes pomaceus (Pers.) Lloyd FIG. 41

Lloyd's Myc. Writ. 3:469. 1910. *Boletus pomaceus* Pers., Obs. Myc. 2:5. 1799. *Polyporus pomaceus* Pers., Myc. Eur. 2:84. 1825. *Polyporus fulvus* Scop. ex Fries, Epicr. Syst. Myc., p. 466. 1838.

Sporophore usually resupinate on the underside of branches and by annual growth forming a subcircular to elongated pendent pileus, rarely strictly sessile and convex to ungulate, woody, up to 3 × 10 × 5 cm., the upper surface gray to grayish-black behind, hirsute to glabrous, with age becoming more or less rimose, somewhat incrusted, the margin brown or gray, obtuse; pore surface brown, the pores round, averaging 4-6 per mm.,

edges rather thick, entire. Context yellowish-brown, woody, up to 8 mm. thick; tubes indefinitely stratified, rather soft-papery, occasionally white-stuffed in the older layers, up to 5 mm. long in a layer.

Context hyphae rarely branched, rather thick-walled, occasionally septate, 3-4 μ in diameter; tramal hyphae similar except somewhat more slender, 2.5-3 μ; hymenial layer 7-10 μ thick; setae infrequent, sometimes apparently absent, ventricose, 10-16 $\times$ 6-8 μ, projecting up to 10 μ beyond the hymenium; basidia clavate, 8-11 $\times$ 5.5-6.5 μ; spores hyaline, smooth, oval to subglobose, 4-5 $\times$ 4-4.5 μ.

On wood of drupaceous hosts from Maine to Georgia westward to the prairies, and from Mexico north to Montana and Manitoba; found throughout the Northern Hemisphere. This is scarcely more than a form of *Fomes igniarius,* dwarfed because of its occurrence on small branches.

The fungus is associated with a soft white rot, see Baxter, Mich. Acad. Sci., Arts, Letters, Papers 19:318-320. 1934; Cartwright and Findlay, 1950, p. 108; Eileen Fisher, Brit. Myc. Soc. Trans. 19:102-113. 1935, and Rivera, Boll. mensile della R. Staz. di Patologia vegetale 2(1-4): 28-29. 1921 (reviewed in Rev. Appl. Myc. 1:23. 1922).

42. Fomes sarcitus (Fries) Cooke

FIG. 42

Grevillea 14:19. 1885. *Polyporus sarcitus* Fries, Vetensk.-soc. Upsala Nov. Acta 3(1):66. 1851 (UPS, BPI, NY).

Sporophore solitary or imbricate, sessile, rigid, of medium weight; pileus conchate to applanate, usually more or less constricted at the base and attached on the upper side, thus often more or less pendent, up to 10 $\times$ 12 $\times$ 3 cm., the upper surface reddish-brown to blackish, strigose varying to more or less hirsute, usually with blackened, distinct, narrow zones, shallowly sulcate, the margin thin, acute to rounded, concolorous; pore surface yellowish-brown, the pores round, 7-8 (-10) per mm., the dissepiments thick, entire. Context reddish-brown, fibrous, black and indurated above, sometimes with white mycelial cords, up to 3 mm. thick; tubes indistinctly stratified, firm-corky to papery, each layer up to 6 mm. thick.

Context hyphae with orange-brown stain in KOH, rarely branched, thin- to thick-walled, rarely septate, 3-8 μ in diameter, the tramal hyphae similar except 2.5-4 μ in diameter; hymenium 11-13 μ thick; setae rather abundant, subulate to somewhat ventricose, 13-24 $\times$ 5-9 μ; spores not wholly certain, probably hyaline, smooth, oval to subglobose, 2.5-3 $\times$ 1.5-2 μ.

Presumably on hardwoods, the rot unknown, in Mexico, Costa Rica, and St. John Is. Previously known only from the type collection from St. John Is., it is now represented by 9 collections from Costa Rica and 2 from Mexico.

The usually thin sporophore with its unique strigose cover distinguishes the species, and these characteristics superficially would seem to refer the plant to *Polyporus*. Specimens are usually sterile, and the spore record here is based on a few spores lying along the hymenium in two specimens. The type is sterile.

cc. *Setae uncinate, at least in part*

43. Fomes zealandicus Cooke

FIG. 43

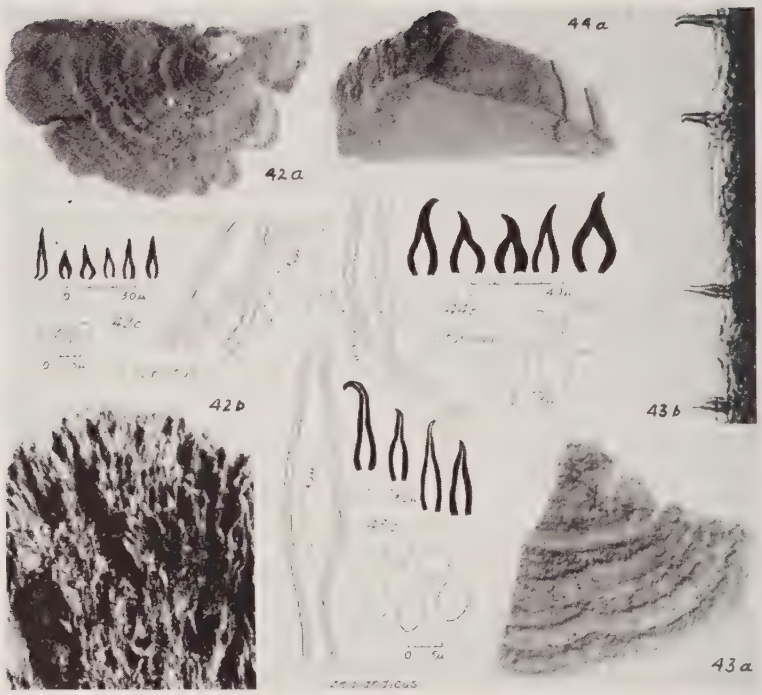
Grevillea 14:18. 1885. *Polyporus zealandicus* Cooke, Grevillea 8:55. 1879 (K, BPI, NY). *Pyropolyporus robinsoniae* Murr., North Amer. Flora 9:108. 1908 (NY, BPI).

Sporophore solitary or imbricate, effused-reflexed to sessile, firm to woody; pileus applanate to convex, up to 10 × 15 × 6 cm., the upper surface reddish- or purplish-brown, sometimes blackening, often becoming glabrous, rather smooth to pitted and rough, narrowly or rarely widely sulcate, at first velvety along the margin, this usually soon disappearing, edge usually thin, rarely thick and rounded, even or somewhat undulate; pore surface reddish-brown, the pores round, in age subangular, averaging 5-7 per mm., edges at first thick, becoming thin, entire. Context reddish-brown, with a faint black line above or without any line, firm, up to 1 cm. thick; tubes usually indistinctly stratified, sometimes distinctly so, firm to almost woody, up to 10 mm. long in each layer.

Context hyphae rarely branched, thick-walled, with very rare septa, 2-4 μ in diameter, the tramal hyphae similar; hymenial layer 10-13 μ thick; setae usually abundant, more or less ventricose, some to nearly all with curved apices, 25-40 × 6-12 μ; basidia about 10-12 × 5-7 μ; spores hyaline, smooth, oval to subglobose, 4-6 × 2.5-4.5 μ.

On wood, presumably of angiosperms, in Tenn., S. Car., Fla., Jamaica, Cuba, Puerto Rico, Trinidad, Chile, East Tropical Africa, the East Indies, and New Zealand. The fungus is associated with a white pocket rot.

Uncinate setae occur in only one other species treated here, in *F. setulosus* which has shorter, broader setae, 15-30 × 7-16 μ, and larger spores, 5-7 × 4-6.5 μ. *F. caryophylleus* Cooke has similar setae but the spores are colored; for a description see under OMITTED SPECIES. Type material of other species with uncinate setae seem sterile; *F. elaphinus* Bres. and *F. senex* var. *hamatus* Corner, however, do not appear to differ significantly from *F. zealandicus*. *F. rubiginosus* (Berk.) Cooke is similar except that the context hyphae are broader, 4-5 μ in diameter. *F. uncatus* G. Cunningham, recently described, is distinguished by its author from *F. zealandicus* by its ungulate shape and the presence of a definite cuticle. *F. haskarlii* (Lév.) Cooke (Leiden type material in Lloyd Herbarium) should be considered here, as the setae are sometimes somewhat uncinate.



FIGS. 42a, 43a, and 44a. — Habit, respectively, of *Fomes sarcitus* × ½ (Standley 43493, at BPI), of *F. zealandicus* × ½ (paratype no. 310), and of *F. setulosus* × ¼ (type). FIG. 42b. — Upper surface of type material of *F. sarcitus*, × 5. FIG. 43b. — Hymenial surface of paratype of *F. zealandicus* × 200, showing hooked setae. FIGS. 42c, 43c, and 44b. — Setae, spores, and context hyphae of the same except 42c, spores from Standley 42658 (BPI), and in 43c, setae from type of *Pyropolyporus robinsoniae*.

44. Fomes setulosus Lloyd FIG. 44

Mycol. Writ. 4:243. 1915 (BPI).

Sporophore solitary, sessile, medium to rather heavy in weight, convex to ungulate, up to 8 × 12 × 6 cm. (up to 30 × 16 × 15 cm. according to Cunningham), upper surface pale to dark lurid or reddish-brown, glabrous, rather smooth, sometimes broadly sulcate, the margin paler, rounded; pore surface pale to dark reddish-brown, smooth to the touch, the pores round to subangular, 6-8 per mm., edges thick to rather thin, entire. Context bright reddish-brown, rather soft and distinctly fibrous, faintly zonate, indurated above but not forming a crust, up to 3 cm. thick; tubes indistinctly stratified, fragile-corky, each layer up to 5 mm. thick.

Context hyphae dark red-brown in KOH, rarely branching, nonseptate, with walls thin to rather thick, 2.5-5 μ in diam., the tramal hyphae similar except 2.5-4 μ in diam.; setae usually abundant, ventricose, apex

straight or slightly curved, or (in type) often strongly uncinate, 15-30 × 7-16(-20) μ; basidia broadly clavate, 8-10 × 6-8 μ; spores hyaline, smooth, somewhat elongated-triangular to ovoid or oval, 5-7 × 4-6.5 μ.

Known from Costa Rica, presumably on hardwoods, otherwise known from Ceylon and reported from New Zealand, Tasmania, and Australia. It is said to cause a chocolate brown rot of chengal, see Rev. Appl. Mycol. 7:704. 1928. The Costa Rican collection differs from the type in having more narrow setae, 7-12 μ in diam., in contrast to the type which has setae 11-20 μ in diam. This difference, although constant, does not appear to warrant specific distinction.

This species differs in microscopic characteristics from *F. zealandicus* which has longer, more slender setae, 25-40 × 6-12 μ, and smaller spores, 4-6 × 2.5-4.5 μ. *F. senex* var. *bulbosetosus* Corner may be a synonym but, in type material, the few spores seen, of uncertain origin, were much smaller, about 3 μ in diameter. The type of *F. squarrosus* Lloyd appears to be lost; Lloyd has placed it in synonomy with his earlier *F. setulosus*. Brazilian material determined by him as *F. squarrosus* has brown spores, and represents a species otherwise unknown to me.

SECTION THREE

Context orange-red or brick-red; spores pale brown or hyaline.

The species in this section have been referred also to the genera *Phellinus* and *Pyropolyporus*. With the exception of *F. albomarginatus* the species named below have somewhat similar spores and appear to form a distinctive group. These may be placed in a series depending on pore size. *F. perlevis* Lloyd, with pores 1.5-2 per mm., overlaps the pore size of *F. demidoffii*, which has pores 1.5-3 per mm., but seems to be a valid species, differing as described under *F. demidoffii*. *F. tricolor* (Murr.) Sacc. & Trott. and *F. fulvo-umbrinus* Bres. have pores 5-6 per mm. and similar oblong-ellipsoid spores 3-4 μ wide; they may be synonymous although *F. fulvo-umbrinus* is so far known only in the resupinate condition. *F. lateritius* Cooke and *F. elegans* Wakefield have pores 8-9 per mm. but seem to differ from each other in the diameter of their context hyphae, 2.5-5 μ in *F. elegans*, 4-8 μ in *F. lateritius*.

KEY TO THE SPECIES

1. Pores 1.5-3 per mm.; on living *Juniperus* ..... 45. *F. demidoffii*
1. Pores 6-8 per mm. or smaller; on dead wood 46. *F. albomarginatus*

45. Fomes demidoffii (Lév.) Cooke FIG. 45

Grevillea 14:19. 1885. *Polyporus demidoffii* Lév. in Demidoff, Voy. Russ. Merid. 2:92. 1842 (PC, BPI, FH). *Polyporus juniperinus* von Schrenk, U. S. Dept. Agr. Veg. Phys. Path. Bul. 21:9. 1900 (BPI). *Pyropolyporus earlei* Murr., Torrey Bot. Club Bul. 30:116. 1903 (NY, BPI).

Sporophore sessile, woody, of medium weight; pileus ungulate, up to 10 × 15 × 5 cm., the upper surface blackening, glabrous, often becoming strongly rimose, the margin rounded, yellowish-brown, velvety; pore surface pale yellowish- or reddish-brown, the pores rounded, averaging 1.5-3 per mm., edges thick, entire. Context at first yellowish, becoming brick-red, firm, not fibrous, up to 6 mm. thick; tubes indistinctly stratified, up to 10 mm. long in each layer.

Context hyphae rarely branched, thin- to thick-walled, nonseptate or rarely septate, 2-4 μ in diameter, the tramal hyphae nonseptate, thin-walled, 1.5-3 μ in diameter; setae none; spores pale reddish-brown or

sordid olive-yellow, smooth, somewhat oblong or appearing truncate, 5-9 × 4-6 μ.

On living *Juniperus* from N. J. southward and westward to California and Oregon; known also from Africa and southern Russia. The brick-red context is characteristic, as are the more or less truncate spores. The host substratum is also very specific. *F. perlevis* Lloyd is quite similar, but differs in its large, rather light sporophore, with matted rusty cream upper surface, rather larger pores, 1.5-2 per mm., somewhat larger context hyphae 3-5 μ in diameter, and perhaps slightly shorter spores 5.5-7 μ long.

The fungus causes a large pocket rot with the pockets lined with white cellulose fibers, see Dowson, Ann. Appl. Biol. 8:95. 1921; Hedgcock and Long, Mycologia 4:109-114. 1912; Troup, Report on Forestry in Kenya Colony, pp. 25-26. 1922; and von Schrenk, U. S. Dept. Agr. Veg. Phys. Path. Bul. 21. 1900.

FIGS. 45a and 46a and b. — Habit, respectively, of the type of *F. demidoffii* × ½, and of *F. albomarginatus* × 1 (specimen collected in British Honduras by Peck, now at NY). FIGS. 45b and 46c. — Context hyphae and spores of the same, except in 46c the spores from Weir 4203 (BPI).

46. Fomes albomarginatus (Zipp. ex Lév.) Cooke FIG. 46

Grevillea 14:19. 1885. *Polyporus albomarginatus* Zipp. ex Lév., Ann. Sci. Nat. Bot. 3, 2:191. 1844 (PC, BPI). *Polyporus kermes* Berk. & Br., Linn. Soc. Bot. Jour. 14:49. 1875 (K, BPI).

Sporophore occasionally resupinate or effused-reflexed, usually sessile, hard, brittle, very light in weight; pileus applanate, up to 7 × 10 × 2 cm., the upper surface pale yellowish-brown to dark rusty-red or dark livid, glabrous, usually wrinkled, sometimes scrupose, frequently with a thin crust, in older specimens growing under apparently favorable conditions narrowly zonate, scarcely sulcate, the margin highly variable, acute, sometimes minutely pubescent, paler, rarely the paler color continued over much of the upper surface; pore surface sometimes receding in each layer, near the margin paler and as wide as 1 cm., within dull

orange-red or glaucous-orange, rarely paler to cream, the pores round to somewhate angular, 6-8(-10) per mm., edges becoming thin, entire. Context orange to brick-red, soft and spongy-fibrous, up to 1 cm. thick, often much less; tubes usually in distinct layers, up to 5 mm. long in each layer.

Context hyphae rarely branched, thin- to more often thick-walled, nonseptate, 4-6 μ in diameter, the tramal hyphae similar; hymenial layer 6-10 μ thick; cystidia none; hyphal pegs projecting up to 19 μ, up to 16 μ in diameter; basidia cylindrical to clavate, firmly compacted, 5-6 $\times$ 2.5-3.5 μ; spores not present on type, on Weir 4203 (BPI) the few seen were hyaline, smooth, cylindrical, straight to curved, 2.5-3 $\times$ 0.5-0.75 μ.

On wood, presumably of angiosperms, from British Honduras (M. E. Peck, at NY); a frequent species in the East Indies; known also from Africa. The rot is unknown. Sporophores of this species are almost invariably sterile. If the spore record given above is correct, this species is very dissimilar to the others placed in this group, all of which usually have abundant, larger, often slightly colored spores. According to Bresadola (Hedwigia 51:311. 1912) *F. pyrrhocreas* Cooke, *Polyporus laeticolor* Berk., and *P. ochrocroceus* P. Henn. are synonyms.

The absence of spores will help to separate this species from *F. lateritius* and *F. elegans*. The first was described as having a larger sporophore with a "hard horny cuticle"; it has faintly colored spores 5 $\times$ 4-4.5 μ. The latter species is more similar to *F. albomarginatus* but has somewhat more slender context hyphae 2.5-5 μ in diameter, and abundant truncate spores 5-6 $\times$ 3.5-5 μ.

SECTION FOUR

Context pink or rose, often fading in old dry specimens; spores hyaline. The species in this group have been referred to *Fomes* by most authors. The section is a somewhat heterogeneous one, as the first 3 species, *F. fraxineus, F. hemileucus,* and *F. rubritinctus* are unrelated to each other or to the remaining species, which form, particularly in *Trametes*, a well-marked group with many tropical relatives. The interrelations of these are difficult to learn, as specimens are very often sterile.

KEY TO THE SPECIES

1a. Pores 2-3 per mm.
  2a. Pileus convex to ungulate, becoming quite large; context hyphae 2-4 μ in diameter ..... 49. *F. rubritinctus*
  2b. Pileus applanate; context hyphae mostly 4-6 μ in diameter ..... 50. *F. sagraeanus*
1b. Pores 3-8 per mm.
  3a. Upper surface laccate with a bright to dark red crust ..... 47. *F. hemileucus*
  3b. Upper surface not laccate, usually not red
    4a. Spores ovoid to subglobose ..... 48. *F. fraxineus*
    4b. Spores cylindrical to ellipsoid
      5a. Pores 3-5 per mm., rarely smaller
        6a. Spores straight, 2-3 μ in diameter ..... 54. *F. roseus*
        6b. Spores sometimes allantoid, 1.5-2.5 μ in diameter ..... 53. *F. cajanderi*
      5b. Pores 5-8 per mm.
        7a. Upper surface pale brownish, darkening with age; context distinctly pink, the hyphae thin-walled; spores usually somewhat pointed at the ends ..... 51. *F. feei*
        7b. Surface black from the first; context pale pink or pinkish-tan, the hyphae thick-walled to solid; spores oblong-ellipsoid, not pointed ..... 52. *F. dochmius*

I. *Pileus laccate in the older portion*

47. Fomes hemileucus (Berk. & Curt.) Cooke — Fig. 47

Grevillea 14:19. 1885. *Polyporus hemileucus* Berk. & Curt., Linn. Soc. Bot. Jour. 10:312. 1868 (K-lectotype, Wright 167, also FH).

Sporophore sessile, firm, light in weight; pileus applanate to convex, up to 8 × 15 × 2 cm., the upper surface in the older portion laccate, with a thin bright to dark red crust, glabrous, azonate, a marginal portion similar, or not laccate and pale, yellowish to concolorous with the pore surface which is pale pinkish-brown to reddish-brown, the pores round, 5-7 per mm., edges thick or rather thick, entire. Context pale pinkish-brown or in age pale yellowish-brown, soft-corky and fibrous, azonate or very faintly zonate in the older portion with a thin dark crust above, up to 1.5 cm. thick; tubes in one or two layers, the older pale yellowish-stuffed, very indistinctly stratified, up to 1 mm. long each season.

Context hyphae apparently solid or nearly so, nonseptate, of two types, the larger rarely branched, 4-8 μ in diameter, mixed with a variable amount of often branched hyphae 1.5-4 μ in diameter, or some thin-walled and frequently collapsed; tramal hyphae similar; hymenial elements not found.

On wood, presumably of angiosperms, in Cuba. The rot is unknown. The pale pinkish-brown context allies this species to *Fomes dochmius,* which differs in having a black, nonlaccate upper surface, and usually more slender context hyphae.

The original material of this species is mixed; for a full account see Lowe (1955, p. 218).

II. *Pileus not laccate; spores 5-6 μ wide*

48. Fomes fraxineus (Bull. ex Fries) Cooke FIG. 48

Grevillea 14:21. 1885. *Boletus fraxineus* Bull., Herb. France, pl. 433, fig. 2. 1790. *Polyporus fraxineus* Bull. ex Fries, Syst. Myc. 1:374. 1821. *Polyporus induratus* Lloyd, Mycol. Writings C. G. Lloyd 5, Letter 68:11. 1918 (BPI).

Sporophore annual or more rarely perennial, often imbricate, sessile, corky when fresh, rigid and woody when dry; pileus plane to convex, up to 10 × 15 × 4 cm., the upper surface light colored, with reddish or reddish-brown stains, or altogether reddish, becoming darker with age, minutely velvety to glabrous, with a thin hard crust; pore surface whitish to flesh-colored, the pores round to somewhat angular, averaging 4-6 per mm., edges moderately thick to thick, entire. Context somewhat flesh-colored when fresh, often fading on drying, punky or soft-corky, up to 3 cm. thick; tubes often in a single layer, the layers very indistinct, up to 10 mm. long in each layer.

Context hyphae rarely branched, thick- or rarely in part thin-walled, usually nonseptate, 5-9 μ in diameter; tramal hyphae similar, 3-8 μ in diameter; hymenial layer 11-14 μ thick; cystidia none; basidia almost subglobose, 11-13 × 8-10.5 μ; spores hyaline, smooth, apiculate, ovoid to subglobose, 6-7 × 5-6 μ.

On the wood of deciduous trees at scattered stations in the eastern United States and eastern Canada; throughout the Northern Hemisphere. The fungus is associated with a white rot, see Cartwright and Findlay, 1950, p. 104; and Montgomery, Ann. Appl. Biol. 23:465-486. 1936. Thick specimens with faded context may be confused with *F. pinicola* which has narrower basidia, 5-8 μ wide, more narrow spores, 3-4 μ wide, and is associated with a brown cubical rot.

According to Pilát (1936-42, p. 357) Bulliard's species is the same as *F. ulmarius*. He uses the name *F. cytisinus* (Berk.) Gill. for the plant described here.

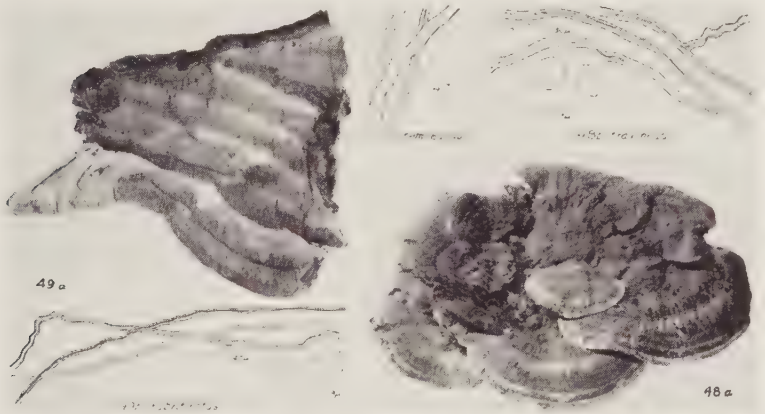


FIG. 47. — *Fomes hemileucus*. Context hyphae from lectotype material, Wright 167. FIGS. 48a and 49a. — Habit, respectively, of *F. fraxineus* × ⅙, specimen in College of Forestry Herbarium, and lectotype of *F. rubritinctus* × 4/10 (Macbride 110, at NY). FIGS. 48b and 49b. — Context hyphae and spores from the same specimens.

III. *Pileus not laccate; spores 1.5-3 μ wide*

A. *Pores 2-3 per mm.*

49. Fomes rubritinctus Murr. FIG. 49

Torrey Bot. Club Bul. 30:232. 1903 (NY-lectotype, BPI, IA). *Fomes laminatus* C. L. Smith, *nomen nudem* in Central Amer. Fungi No. 138. 1896.

Sporophore sessile, hard and woody, light in weight when dry; pileus convex to ungulate, up to 12 × 15 × 10 cm., the upper surface pale reddish-brown, in age usually darkening, at first smooth, in age roughening, the margin obtuse; pore surface when dry brownish, evidently darkening where bruised when fresh, the pores subangular, averaging 2-3 per mm., edges moderately thin, entire. Context pale pinkish wood-color or somewhat darker, firm-corky, faintly zonate, without a crust, up to

1.5 cm. thick; tubes distinctly stratified with layers separated by context or more often by tubes completely stuffed to a thickness of 5 mm., rather hard, brittle, and somewhat resinously indurated in age, up to 1.5 cm. long in a layer.

Context hyphae rarely branched, usually solid or nearly so, nonseptate, 2-4 μ in diameter; tramal hyphae similar; cystidia none; spores hyaline, smooth, oblong-ellipsoid, 5-7 $\times$ 2-2.5 μ.

Presumably on wood, known only from a single collection from Nicaragua and distributed as No. 138 in C. L. Smith's Central American Fungi. The rot is unknown.

Polyporus scleromyces Berk. & Curt. is considered a synonym by Bresadola (1920, p. 68; 1926, p. 80). Type material of this (K, BPI) is sterile, and agrees with *F. rubritinctus* except that the pores are slightly smaller, 4 per mm., and the context hyphae are thinner-walled. In a herbarium note Bresadola also says, "vix differt a *Fomite semitosto* Berk." Type material of the last is sterile, and appears to differ in having smaller pores, 5-6 per mm.

The specimen in the packet of Smith's Central American Fungi No. 138 in the herbarium of the New York Botanical Garden is a sterile fragment. It is obvious that Murrill made his description from another specimen, a median section of a large sporophore that was cut up for exsiccatae distribution. This large fertile section is considered the lectotype.

AA. *Pores 3-8 per mm.*

50. Fomes sagraeanus (Mont.) Murr. FIG. 50

North Amer. Flora 9:96. 1908. *Polyporus sagraeanus* Mont., in de la Sagra, Plant. Cell. Cuba, p. 409. 1842 (PC).

Sporophore sessile, firm-corky; pileus conchate to applanate, up to 8 $\times$ 14 $\times$ 0.7 cm., the upper surface pale brownish-pink, subsilky, with a matted, very delicate cover but not pubescent, faintly and narrowly zonate, somewhat radiate-striate, the margin thin, acute; pore surface quite dark pinkish-brown, the pores subangled, averaging 3 per mm., the edges rather thin, entire. Context brownish-pink, tough but rather soft, fibrous, faintly zonate; tubes in a single layer up to 2 mm. thick.

Context hyphae rarely branched, thin- to thick-walled, nonseptate, mostly 4-6 μ in diameter, with some more slender hyphae 3-4 μ in diameter that are occasionally branched, the tramal hyphae similar; hymenial elements not present.

The concept given is based upon No. 865 in the Montagne collection, the only well-developed specimen in the original collections. Three other much smaller pieces are too poorly developed to be determined with certainty. No other collections are known.

The type material includes Leprieur Nos. 861 and 865. These appear to be the same plant, although Lloyd (1915, p. 226) refers No. 865 to *Trametes cupreo-rosea* (Berk.) Lloyd. The sporophore of *F. sagraeanus* is very similar to that of *F. feei* except for pore size, which is 5-6 per mm. in the latter species.

51. Fomes feei (Fries) Lowe

FIG. 51

Mycologia 47:217. 1955. *Polyporus feei* Fries, Linnaea 5:518. 1830 (PC, K, NY).

Sporophore solitary or imbricate, sessile, corky to woody, rather light in weight; pileus conchate to applanate, up to 6 × 10 × 2 cm., the upper surface pale brownish, darkening to brown or black or grayish, velvety, becoming glabrous, more or less sulcate, sometimes horny-incrusted with age, the margin thin; pore surface pale rose-colored or pale pinkish-brown, the pores round, 5-6 per mm., the edges thick to rather thin, entire. Context flesh color or light pinkish-brown, rather soft to corky, fibrous, up to 1 cm. thick; tubes indistinctly stratified, up to 5 mm. long in a layer, often in only one layer.

Context hyphae usually rarely branched, mostly thin-walled and non-septate, with a variable amount of very thin-walled, probably clamped hyphae 3-6 μ in diameter, the tramal hyphae similar; hymenial layer 13-16 μ thick; cystidia none; basidia clavate, 10-16 × 4-6 μ; spores hyaline, smooth, oblong-ellipsoid, usually somewhat pointed at the ends, 5-8 × 2-2.5 μ.

On wood of angiosperms throughout the tropical and subtropical regions of America. The rot is unknown. The sporophore most nearly resembles those of *F. sagraeanus* which differ in having larger pores, 3 per mm. It could also be confused with *F. dochmius* which has, in contrast, the upper surface black from the first.

52. Fomes dochmius (Berk. & Br.) Cooke

FIG. 52

Grevillea 14:17. 1885. *Polyporus dochmius* Berk. & Br., Linn. Soc. Bot. Jour. 14:50. 1875 (K, BPI). *Fomes subferreus* Murr., North Amer. Flora 9:97. 1908 (NY, BPI).

Sporophore solitary or imbricate, effused-reflexed or more often sessile, corky, rather light in weight; pileus conchate to applanate or convex, up to 10 × 13 × 3 cm., the upper surface at first black, in age becoming more or less gray, glabrous, sulcate, often faintly zoned, in drying often indistinctly radially wrinkled and cracked, the margin narrowly pale cream, soon becoming black, minutely velvety, becoming glabrous the second year; pore surface pale cream to cream, the pores round or occasionally coalescing and subdaedaloid, 5-8 per mm., edges thick, entire. Context

pale pink or pinkish-tan, or becoming wood-color in old specimens, punky, distinctly fibrous where broken, up to 1.5 cm. thick, without a distinct crust; tubes usually indistinctly stratified, sometimes with a context layer between tube layers, corky, up to 7 mm. long in a layer.

Context hyphae rarely branched, thick-walled to solid, nonseptate, 2-6 μ in diameter; tramal hyphae similar except more slender, 2.5-4 μ in diameter; hymenial layer 10-13 μ thick; cystidioles occasional, scarcely projecting, about 3-4 μ in diameter; basidia very narrowly clavate, 13-19 $\times$ 4-5 μ; spores hyaline, smooth, oblong-ellipsoid, 4.5-6 $\times$ 2-2.5 μ.

On wood of angiosperms in Guatemala, British Honduras, Costa Rica, Panama, Jamaica, and Cuba; in South America and the East Indies and probably distributed throughout the tropics. The fungus is associated with a brown rot.

Sporophores are similar to those of *F. feei* except that the upper surface in that species is at first pale brownish, and darkens with age. According to Bresadola (Ann. Myc. 14:224. 1916) *F. dochmius* is synonymous with *F. nubilis* (Fries) Cooke.

FIGS. 50, 51a, and 52a. — Habit, respectively, of *Fomes sagraeanus* $\times$ ½ (type, No. 865), of *F. feei* $\times$ ½ (type) and of *F. dochmius* $\times$ ¾ (type). FIGS. 51b and 52b. — Context hyphae and spores of the same species, 51b from Rose, Standley, and Russell 12691 (NY); 52b from type of *F. subferreus*.

53. Fomes cajanderi Karst. FIG. 53

Finska Vet.-Soc. Öfv. Förh. 46 (11):8. 1904 (H, BPI). *Pycnoporus mimicus* Karst., Trav. Sous-Sect. Troitzk-Kiakhta, Sect. Pays d'Amour Soc. Imp. Russe Geog. 8(1):62. 1906 (H, BPI). *Trametes subrosea* Weir, Rhodora 25:217. 1923. *Trametes carnea* Amer. aut., not *T. carnea* (Blume & Nees) Wettstein. *T. arctica* Berk. in herb.

Sporophore annual or perennial, solitary or imbricate, sessile or effused-reflexed, coriaceous to rigid; pileus conchate to applanate, up to 5 × 7 × 0.7 cm., the upper surface pinkish to rose, becoming grayish to black with age, at first velvety-tomentose, becoming radially appressed-fibrillose to nearly glabrous, sometimes scabrous with minute tufts of short erect hairs, zonate to azonate, the margin thin; pore surface pinkish or rosy, the pores round to slightly angular, averaging 3-5 per mm., edges moderately thick, entire. Context pinkish to rose-colored, corky, indistinctly zonate, up to 5 mm. thick; tubes distinctly stratified, corky, white-lined, up to 3 mm. thick in a layer.

Context hyphae rarely branched, thin- to moderately thick-walled, nonseptate, mixed with a small amount of thin-walled clamped hyphae, 3-5 μ in diameter; tramal hyphae similar; hymenial layer 13-15 μ thick; cystidia none; basidia clavate, 12-14 × 4-6 μ; spores hyaline, smooth, cylindrical, usually more or less allantoid, 5-8 × 1.5-2.5 μ.

On the wood of gymnosperms or rarely of angiosperms from Quebec to Florida westward to California and British Columbia; throughout the North Temperate Zone.

This fungus was known to the earlier American mycologists as *Trametes carnea*. According to Lloyd (cited below) and Weir (cited above) it is not the same as *T. carnea* described from Java; Pilát (1936-42, p. 320) on the other hand thinks they are synonymous. *F. palliseri* (Berk.) Cooke is often cited as a synonym, perhaps incorrectly, see Myc. Writings C. G. Lloyd 3, Letter 32:4. 1911, and 4:283. 1915; see also Bresadola in Hedwigia 51:311. 1912, and in Ann. Myc. 14:237. 1916.

The fungus is associated with a brown rot of the wood of gymnosperms or rarely of angiosperms, see Baxter, Michigan Acad. Sci., Arts, Lett. Papers 35:49-58. 1951; Korstian and Brush, U.S.D.A. Tech. Bul. 251, p. 14. 1931; Snell, Mycologia 15:158-159. 1923; and Zeller, Jour. Agr. Res. 33:687-693. 1926.

54. Fomes roseus (Alb. & Schw. ex Fries) Karst. FIG. 54

Soc. F. F. Fenn. Meddel. 5:39. 1879. *Boletus roseus* Alb. & Schw., Consp. Fung., p. 251. 1805. *Polyporus roseus* Alb. & Schw. ex Fries, Syst. Myc. 1:372. 1821.

Sporophore sessile, woody, of medium weight; pileus convex to more commonly ungulate, up to 7 × 10 × 3 cm., the upper surface tan with reddish tints, becoming more or less black, glabrous or rimose with age, sulcate, sometimes slightly incrusted, the margin obtuse; pore surface pinkish or rosy, or somewhat whitened, the pores round, 3-6 per mm., edges usually thick, entire. Context pinkish or rose-colored, soft-corky to hard, indistinctly zonate, up to 10 mm. thick; tubes distinctly to indistinctly stratified, white-stuffed in the older layers, white-lined in the younger ones, up to 3 mm. long in a layer.

Context hyphae rarely branched, appearing solid but apparently mostly thin-walled with opaque content, sometimes surely thick-walled, 2.5-4 μ in diameter, nonseptate, the tramal hyphae often thin-walled, 1.5-4 μ in diameter; hymenial layer 10-13 μ thick; cystidia none; basidia clavate, 11-13 $\times$ 5-8 μ; spores hyaline, smooth, cylindrical, straight, 5-8 $\times$ 2-3 μ.

On the wood of gymnosperms from Quebec to Maine westward to Ontario and New York, and in the West from New Mexico northward to British Columbia; in Jamaica and throughout the Northern Hemisphere. This species is very similar to *Fomes cajanderi* except for the straight, thicker spores; for a comparison on cultural and morphological grounds see Mounce and Macrae, Canad. Jour. Res. 15:154-161. 1937.

The fungus is associated with a brown top rot of conifers, see Boyce, U.S.D.A. Tech. Bul. 286, p. 28. 1932; and Eades, Dept. Int. Canada Forest Serv. Bul. 80, pp. 79, 81. 1932.

FIGS. 53a and 54a. — Habit, respectively, of *Fomes cajanderi* $\times$ ⅓ (Lowe 7687), and of *F. roseus* $\times$ ½ (Lowe 1715). FIGS. 53b and 54b. — Context hyphae and spores of the same species, 53b from type material (BPI), and 54b from Lowe 1715.

SECTION FIVE

Context white or cream to pale brownish; spores hyaline.

Species in this section are placed in the genus *Fomes* by most authors; additional generic names which include this concept, at least in part, are *Fomitopsis, Oxyporus, Rigidoporus, Ungulina,* and others. The majority of the species occur in the North Temperate Zone and their identity is well-known; the tropical representatives are few, especially in comparison with the greater variety of species with brown context.

KEY TO THE SPECIES

1a. Context hyphae septate
  2a. Pores 5-9 per mm.
    3a. Context hyphae thin-walled, often collapsed in dried specimens, inconspicuously septate ..... 60. *F. ulmarius*
    3b. Context hyphae not collapsing, uniformly 3-5 μ in diameter, conspicuously septate ..... 61. *F. auberianus*
  2b. Pores 2-5 per mm.
    4a. Sporophore small; pores 4-5 per mm.; spores 4.5-5 × 3-4 μ, or 3-4 μ in diameter ..... 55. *F. connatus*
    4b. Sporophore very large; pores 2 per mm. (smaller when dry); spores 6-7 × 3.5-4 μ ..... 56. *F. nobilissimus*
1b. Context hyphae nonseptate, at least the principal hyphae
  5a. Spores cylindrical to narrow-ellipsoid
    6a. Spores narrow-ellipsoid with one end attenuate; sporophore large
      7a. Context hyphae mostly 2-4 μ in diameter ..... 57. *F. sulcatus*
      7b. Context hyphae 4-8 μ in diameter ..... 58. *F. ligneus*
    6b. Spores cylindrical; sporophore small ..... 59. *F. scutellatus*
  5b. Spores ellipsoid to globose
    8a. Spores 7-13 × 5-8 μ
      9a. Sporophore becoming large, more or less rimose; spores 7-11 μ long ..... 62. *F. fraxinophilus*
      9b. Sporophore remaining small, not rimose above; spores 10-13 μ long, truncate at one end ..... 63. *F. ohiensis*
    8b. Spores smaller, 4-7 × 2-5 μ
      10a. Spores often more or less truncate; context hyphae usually 2-4 μ in diam.; sporophore resupinate or only slightly reflexed

11a. Context corky-fragile, usually becoming somewhat brownish, the hyphae frequently intricately branched, 1.5-3 μ in diam.; pores 5-8 per mm.; spores 4-7 × 2.5-5 μ ..... 64. *F. unitus*

11b. Context soft-fibrous, cream, the hyphae rarely branched, 2-4(-5) μ in diam.; pores 8-9 per mm.; spores 4-5 × 2-3 μ ..... 68. *F. contrarius*

10b. Spores rounded, not truncate; context hyphae usually 4-5 μ in diam. or more; sporophore subresupinate only in No. 67.

12a. Sporophore often pendent; context extremely bitter, friable when dry, white ..... 65. *F. officinalis*

12b. Sporophore sessile or subresupinate; context tasteless or somewhat resinous, corky, pallid to light brown or light yellow or with a pinkish tinge

13a. Sporophore usually sessile, thick; spores 5-7 μ long ..... 66. *F. pinicola*

13b. Sporophore often resupinate to effused-reflexed, thin; spores 4.5-5 μ long ..... 67. *F. annosus*

I. *Incrusted cystidia present*

55. Fomes connatus (Weinm.) Gill. FIG. 55

Champ. France 1:684. 1878. *Polyporus connatus* Weinm., Syll. Plant. Nov. Ratisbon. 2:102. 1828. *Fomes populinus* in sense of Cooke, Grevillea 14:20. 1885, and of Murrill in North Amer. Flora 9:99. 1908.

Sporophore often imbricate, sessile or rarely varying to resupinate, corky to somewhat woody, rather light to medium in weight; pileus usually convex to subungulate, up to 10 × 15 × 4 cm., the upper surface white to yellowish, rarely varying to grayish-black, often covered with moss or algal growth, velvety-tomentose to glabrous, even, the margin thick; pore surface white to yellowish, often glistening, the pores angular, averaging 4-5 per mm., edges rather thin, entire to slightly dentate. Context white or whitish, soft-corky to firm, up to 1 cm. thick, without a crust, the tubes distinctly stratified and separated from each other by a thin layer of context, corky, up to 5 mm. long in a layer.

Context hyphae rarely branched, thin-walled, septate, 2-5 μ in diameter, the tramal hyphae similar except 2-3 μ in diameter; hymenial layer about 11 μ thick; cystidia capitate-incrusted, 4-12 μ in diameter, also non-incrusted variously shaped bodies in the hymenium; basidia clavate, 8-10 × 5-6 μ; spores hyaline, smooth, sometimes guttulate, ellipsoid to globose, 4.5-5 × 3-4 μ or 3-4 μ in diameter.

On the wood of deciduous trees, especially maple, from Nova Scotia to Manitoba southward to Georgia and Arkansas; throughout the North Temperate Zone. First season specimens may be confused with *Polyporus,*

but the corky consistency, septate context hyphae, and the conspicuous cystidia and crystals in the hymenium readily distinguish the species. Older specimens are usually covered with moss. *F. nobilissimus* is the most similar species, and these two are sometimes placed in the genus *Oxyporus*, on the basis of perennial sporophores with cystidia. *F. latissimus* Bres. probably belongs in this group as it has cystidia, and also, perhaps, *F. tropicalis* Cooke.

The fungus is associated with a white, soft butt rot, see Baxter, Michigan Acad. Sci., Arts, Lett. Papers 32:205-207. 1948; Nordin, Canad. Jour. Bot. 32:221-258. 1954; Solovieff, Mitt. Forsttech. Acad. Leningrad 6:22-46. 1935 (reviewed in Rev. Appl. Mycology 15:65-66. 1936); and Spaulding, Important Tree Pests of the Northeast, pp. 131-133. 1952.

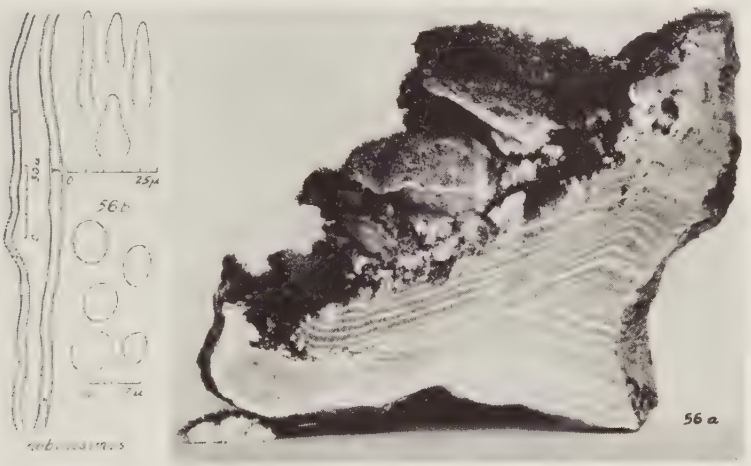


FIG. 56a. — Vertical section of type material of *Fomes nobilissimus* × ⅙; photo by A. H. Smith. FIG. 56b. — Context hyphae, cystidia, and spores from the type material.

56. Fomes nobilissimus (W. B. Cooke) Lowe FIG. 56

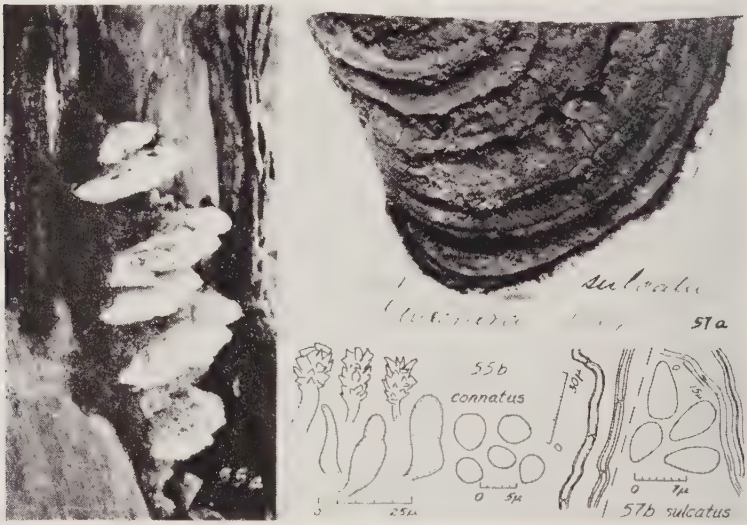
Mycologia 47:219. 1955. *Oxyporus nobilissimus* W. B. Cooke, Mycologia 41:444. 1949 (MICH., NY).

Sporophore imbricate, sessile or centrally substipitate, when dry subwoody, quite light in weight; pilei more or less ungulate, becoming massive, up to 140 × 95 × 100 cm. and up to 136 kg. (300 lbs.) when fresh, the upper surface white, discoloring on drying, densely strigose, the margin obtuse; pore surface white, when dry discolored, often translucent, the pores angular, averaging 5 per mm. on dried specimens, "2 per mm." (Cooke, on a fresh specimen), edges thin, entire to fimbriate. Context white or whitish, in part hard and more or less resinously

streaked, in part softer and transitional with the upper surface covering, up to 6 cm. thick; tubes in distinct layers, separated by context tissue, corky, up to 7 mm. long in a layer.

Context hyphae rarely branched, thin-walled, septate, 3-5 μ in diameter, the tramal hyphae similar; cystidia usually abundant, more or less ventricose, up to 30 μ long and 13 μ in diameter, rounded at the tips, "apex with a crystalline cap" (Cooke); basidia "12-15 $\times$ 4-5 μ" (Cooke); spores hyaline, smooth, rather thick-walled (or "thin-walled", Cooke), oval, 5-6 $\times$ 5 μ, or "6-7 $\times$ 3.5-4 μ" (Cooke).

On wood of living gymnosperms in Washington and Oregon. The fungus is associated with a brown rot. The sporophores are among the largest known. They are somewhat similar to *F. connatus* which, however, has much smaller fruiting bodies on the wood of angiosperms only.



FIGS. 55a and 57a. — Habit, respectively, of *Fomes connatus* about $\times$ ¼ (Lowe 7688), and of *F. sulcatus* $\times$ ½ (type). FIGS. 55b and 57b. — Context hyphae and spores of the same, 55b from Lowe 3688, 57b from type. Fig. 55b includes also incrusted cystidia and unincrusted, thin-walled cystidia-like structures usually present in the hymenium.

II. *Incrusted cystidia absent*

A. *Spores cylindrical to narrow-ellipsoid*

57. Fomes sulcatus Cooke FIG. 57

Grevillea 14:17. 1885 (K). *Polyporus sulcatus* Cooke, the same, vol. 13:32. 1884. *Fomes hippopus* Willd. sense of Bresadola, Soc. Myc. France Bul. 6:XLII. 1890 and Icon. Mycol. 20, tab. 999. 1931 (S, BPI).

Sporophore sessile, hard and heavy; pileus applanate to ungulate, up to 11 × 13 × 5 cm., the upper surface dark reddish-brown or blackish, glabrous, slightly to strongly sulcate, the margin usually obtuse; pore surface cream to pale wood color, the pores rounded or somewhat irregular, averaging 5-6 per mm., edges thick, entire. Context whitish to pale brownish or in part chocolate-brown, firm, tough, above often darkened and hardened into a distinct crust, up to 2 cm. thick; tubes more or less distinctly stratified, spongy-corky, up to 1 cm. long in each layer.

Context hyphae rarely branched, thick-walled, nonseptate, 2-4 (rarely -5) μ in diameter, the tramal hyphae similar except 2-3 μ in diameter; cystidia none; spores hyaline, smooth, narrow-ellipsoid with one end attenuated, 5-11 × 3-5 μ.

On wood in Mexico, Nicaragua, Costa Rica, Cuba, Dominican Republic, and Grenada; found throughout the tropical regions of the world. The sporophore is very similar to that of *F. ligneus* which differs primarily in the diameter of the context hyphae; see the discussion under the next species. *F. hemitephrus* (Berk.) Cooke could be confused with this; it has a pinkish context and, according to Cunningham, smaller spores 4-6 × 2-2.5 μ.

Spores in the type material are 5-7 μ long. Spores up to 11 μ long were found in other material which did not appear to differ otherwise.

58. Fomes ligneus (Berk.) Cooke — Fig. 58

Grevillea 13:119. 1885. *Polyporus ligneus* Berk., Ann. Nat. Hist. 3:387. 1839 (K, BPI). *Polyporus hornodermus* Mont., Ann. Sci. Nat. Bot. 4(5):368. 1856 (S-lectotype, BPI).

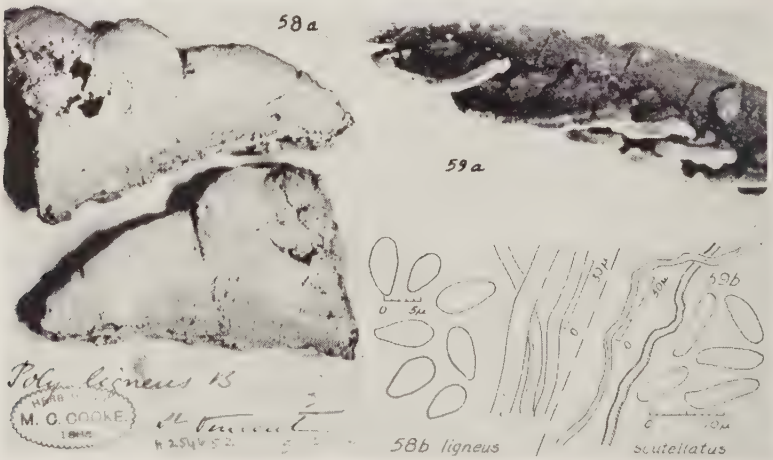
Sporophore sessile or somewhat effused-reflexed, hard, heavy; pileus applanate to ungulate, up to 18 × 30 × 10 cm., the upper surface blackish to black, glabrous, more or less sulcate, with a thin but distinct crust, the margin obtuse; pore surface cream or dirty white, the pores round, averaging 4 per mm., edges thick, entire. Context cream to pale wood color, firm, corky, up to 3 cm. thick; tubes in more or less distinct layers, corky, each layer up to 6 cm. thick.

Context hyphae rarely branched, mostly very thick-walled, nonseptate, 4-8 μ in diameter, the tramal hyphae similar except more slender, 3-4 μ in diameter; cystidia none; spores hyaline, smooth, narrowly ellipsoid, somewhat attenuated at one end, 6-8 × 3-4 μ.

On wood, presumably of angiosperms, in Nicaragua and, originally, from St. Vincent Is., British West Indies, and Mauritius; further distribution uncertain. The species has been confused with *F. sulcatus* both as to its identity and its distribution. It differs from the latter primarily in the size of the context hyphae which are 2-4 μ in diameter in *F. sulcatus*. *F. martius* (Berk.) Cooke appears to be a synonym; the type material (at K) is represented by 2 collections, of which one labelled

"α" is designated as representative of the species by Bresadola. This specimen agrees with the concept of *F. ligneus* given here; it does not show the orange layer under the crust which Lloyd (1915, p. 215) states is an important distinction. Lloyd reports *F. martius* from Central America and the West Indies; there are, however, no specimens from North America so named in his collections and the only North American collection named by him (at S) is *F. ligneus*. *F. hemitephrus* (Berk.) Cooke sometimes has a similar orange zone and has been confused with *F. ligneus*. Isotype material (BPI) is sterile and its relationships are uncertain, but it appears to be a quite different plant.

The type specimen of *Polyporus hornodermus* has not been found. In the Bresadola collections at Stockholm and at Beltsville there is material said to be part of the type, and the Stockholm specimen is selected as lectotype. The material in these packets do not agree, however, with Bresadola's notes on the packets, or with his published notes on this species (Bresadola 1916, p. 236; 1926, p. 27 [or 77]). As the Bresadola material is the only sample known which is supposed to have been part of the type, it must serve for the species until the type can be located.



FIGS. 58a and 59a. — Habit, respectively, of type of *Fomes ligneus* × ½, and of *F. scutellatus* × ½ (specimen in College of Forestry Herbarium). FIGS. 58b and 59b. — Context hyphae and spores of the same species, 58b from Nicaragua specimen in N. Y. Bot. Garden; Fig. 59b from specimen in Col. Forestry Herbarium.

59. Fomes scutellatus (Schw.) Cooke FIG. 59

Grevillea 14:19. 1885. *Polyporus scutellatus* Schw., Amer. Phil. Soc. Trans. II, 4:157. 1832 (PH). *Polyporus perpusillus* Pers. in Lév., Ann. Sci. Nat. Bot. 3(2):191. 1844 (NY-isotype).

Sporophore sessile, corky to woody; pileus usually convex to ungulate, up to 1.5 × 2 × 0.5 cm., the upper surface becoming dark brown to black, velvety, becoming glabrous, somewhat sulcate, the margin rather thick, acute; pore surface white to pallid, the pores round, 4-5(-7) per mm., edges at first thick and obtuse, becoming rather thin, entire. Context white to light brown, corky, up to 2 mm. thick, without a distinct crust; tubes indistinctly stratified, corky, up to 2 mm. long in a layer.

Context hyphae somewhat branched, thin- to thick-walled, nonseptate, 2-4 μ in diameter, intermixed with a small amount of thin-walled clamped hyphae 4-5 μ in diameter, the tramal hyphae similar; hymenial layer 11-17 μ thick; cystidia none; hyphal pegs projecting up to 40 μ, up to 40 μ in diameter; basidia clavate, 10-14 × 5-9 μ; spores hyaline, smooth, cylindrical, 8-10 × 2.5-3.5 μ.

On the wood of *Alnus* and other angiosperms from Quebec to Florida, Puerto Rico, Mexico, and northwestward to British Columbia; reported from New Zealand. The fungus is associated with a white rot. The sporophore is one of the smallest known in the genus *Fomes*. *F. atroalbus* P. Henn. is very similar but is applanate with somewhat shorter spores, 5-6 × 2-2.5 μ, or "6-7 × 2.5-3 μ" (Bresadola).

AA. *Spores ellipsoid to globose*
a. *Principal context hyphae septate*

60. Fomes ulmarius (Sow. ex Fries) Gill. FIG. 60

Champ. France, p. 683. 1878. *Boletus ulmarius* Sow., Coloured Figures English Fungi, tab. 88. 1797. *Polyporus ulmarius* Sow. ex Fries, Syst. Myc. 1:365. 1821.

Sporophore sessile or effused-reflexed, corky when fresh, hard and rigid when dry, the pileus applanate to convex, up to 15 × 25 × 8 cm., upper surface white, drying ochraceous to pale tan or pale bay, somewhat tomentose to glabrous, usually azonate, often pitted and tubercular, the margin rather thick, often deflexed in drying; pore surface pinkish-salmon when fresh, drying sordid flesh-color to smoky grayish, the pores angular, averaging 5-8 per mm., edges thin, entire. Context white to cream, often ochraceous on drying, firm-corky to almost woody when dry, up to 7 cm. thick; tubes very indistinctly stratified, drying cartilaginous and translucent, usually rigid, up to 15 mm. long in a layer.

Context hyphae thin-walled, often collapsed, rarely branched, inconspicuously septate, 3-7 μ in diameter, the tramal hyphae similar except more slender, 3-4 μ in diameter; hymenial layer about 11-16 μ thick; cystidia bulbous, thin-walled, up to 15 μ long, 4-11 μ in diameter at the base; spores hyaline, smooth, globose or nearly so, 5-8 μ in diameter.

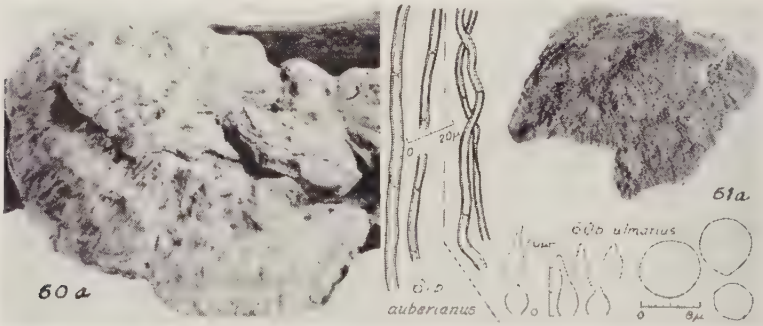
On deadwood or from wounds in living angiosperms from the southeastern United States, Mexico, Honduras, and St. Barthelemy Is. The

taxonomy of this species is too confused to warrant citing distribution records from the literature; the American plant is however like European specimens so named. *F. auberianus* is very similar and perhaps not specifically distinct; that species differs in having context hyphae with stronger walls which do not collapse and are conspicuously septate; and cystidia have not been found.

Fomes lignosus (Klotzsch) Bres., as usually understood, is similar. According to Lloyd (1915, p. 230) this forms usually an annual sporophore which is bright orange on the pore surface when fresh, fading on drying. According to Petch (see Rev. Appl. Mycol. 8:72. 1929), American determinations of *F. lignosus* should be referred instead to *Polyporus microporus* Swartz ex Fries. All these species, *F. auberianus,* and many other tropical ones belong to a group which has been segregated under the generic name *Rigidoporus* whose taxonomy is still in a choatic state.

F. ulmarius has been recognized in American literature under the name *F. geotropus* Cooke. The type of *F. geotropus* came from Demerara, and it appears to differ from the plant here described in the absence of cystidia.

The fungus causes a brown butt rot of elm in England (Cartwright and Findlay, 1950, p. 110).



FIGS. 60a and 61a. — Habit, respectively, of *Fomes ulmarius* × ½ (FP 12338, at BPI), and of *F. auberianus* × ½ (type). FIG. 60b. — Context hyphae and spores (from Lowe 5035), and cystidia (from Earle 9, at NY) of *F. ulmarius*. FIG. 61b. — Context hyphae of *F. auberianus,* from type.

61. Fomes auberianus (Mont.) Murr. FIG. 61

Torrey Bot. Club Bul. 32:491. 1905. *Polyporus auberianus* Mont. in de la Sagra, Plant Cell. Cuba, p. 399. 1842 (PC, BPI).

Sporophore sessile, hard and rigid; pileus applanate, up to 5 × 7 × 1 cm., the upper surface ochraceous to sordid reddish-brown, glabrous, faintly zonate, the margin acute; pore surface tan to discolored more or less blackish, paler toward the margin, the pores angular, averaging 8-9 per mm., edges thin, entire. Context pale yellowish, silky, rather soft,

up to 4 mm. thick; tubes in indistinct layers, rather soft, subcorky, each layer up to 5 mm. thick.

Context hyphae rarely branched, thin-walled, frequently septate, uniformly 3-4 (-5) μ in diameter, the tramal hyphae similar; cystidia none; spores not seen.

Presumably on wood in Cuba. The identity of this fungus has been very much confused, and its distribution is uncertain; it has been reported from throughout the tropics. The fungus belongs, as does the preceding species, to a complex of abundant and highly variable plants which have been described repeatedly as new, and have figured in the literature most commonly as *Polyporus microporus* and *F. lignosus.*

Fomes geotropus is similar, but seems to differ in having a harder context of wood-brown color, resinously indurated tubes, and perhaps by its broadly oval to globose spores 6.5-8 × 5-8 μ.

aa. *Principal context hyphae nonseptate*
b. *Spores often truncate at one end*

62. Fomes fraxinophilus (Peck) Cooke

FIG. 62

Grevillea 15:51. 1886. *Polyporus fraxinophilus* Peck, N.Y.S. Mus. Ann. Rept. 35:136. 1884 (NYS). *Fomes ellisianus* Anderson, Bot. Gaz. 16:113. 1891 (NY).

Sporophore sessile, hard and woody; pileus convex to somewhat ungulate, up 20 × 30 × 10 cm., the upper surface at first white, soon grayish-black to black, velvety, soon glabrous, somewhat rimose with age, sulcate, the margin often remaining light-colored, thick, obtuse to acute; pore surface white to brownish, the pores round to angular, averaging 2-3 per mm., edges thick, entire. Context white to light brown, woody, fissile, up to 1.5 cm. thick, sometimes with a thin crust; tubes indistinctly stratified, concolorous with the context except for the latest growth which is usually lighter in color, often white-stuffed, up to 10 mm. long in a layer.

Context hyphae rarely branched, thick-walled, nonseptate, 3-7 μ in diameter, the tramal hyphae similar except more slender, 3-4 μ in diameter; cystidia none or thin-walled, variable in shape, scarcely projecting, up to 8 μ in diameter; basidia clavate, 13-24 × 8-13 μ; spores hyaline, smooth, ellipsoid to ovoid, often truncate at one end, 7-11 × 5-8 μ.

On living or dead trees, usually ash, but also reported on willow and *Shepherdia* from Quebec south to Tennessee, westward to the prairies, and in the Rocky Mountains. *Polyporus circumstans* Morgan is a synonym according to all recent workers; the type of this species has not been found. The strongly rimose specimens usually referred to *F. ellisianus* appear to be a variation due perhaps to growth under dry conditions.

The fungus is associated with a white mottled heartrot of ash, see Baxter, Amer. Jour. Bot. 12:553-562. 1925; von Schrenk, U.S.D.A. Plant Ind. Bul. 32. 1903; and von Schrenk and Spaulding, U. S. Dept. Agr. Pl. Ind. Bul. 149:46, 47. 1909.

FIGS. 62a and b, and 63a and b. — Upper surface and sectional view, respectively, of *Fomes fraxinophilus* × ½ (type), and of *F. ohiensis* × 1 (Lowe 1593). FIGS. 62c and 63c. — Context hyphae and spores of the same; also, in 62c, cystidia.

63. Fomes ohiensis (Berk.) Murr. FIG. 63

Torrey Bot. Club Bul. 30:230. 1903. *Trametes ohiensis* Berk., Grevillea 1:66. 1872 (K, NY).

Sporophore sessile or rarely resupinate, firm, corky to subwoody, of medium weight; pileus convex to ungulate, up to 2.5 × 3 × 1 cm., the upper surface at first white, darkening and becoming black at the base but remaining white at the margin, the older area becoming glabrous, often sulcate, the margin finely tomentose or matted, often wide, sometimes zonate, acute to obtuse; pore surface white, darkening to cream, the pores round, averaging 3-5 per mm., edges remaining rather thick, entire. Context white to light brown, corky, up to 3 mm. thick, without a distinct crust; tubes indistinctly stratified, corky, up to 5 mm. long in a layer.

Context hyphae rarely branched, mostly thick-walled, nonseptate, 2-5 μ, mostly 3-4 μ in diameter, the tramal hyphae similar; hymenial layer 13-20 μ thick; cystidia none; basidia clavate, 14-21 × 9-13 μ; spores hyaline, smooth, ellipsoid to ovoid, with one end truncate, 10-13 × 5-8 μ.

On wood of angiosperms or on cut hardwood timbers from Ontario and Massachusetts south to North Carolina and westward to the prairies, and in Florida, Jamaica and Cuba. The fungus is associated with a white

rot. The small size of the sporophore and the truncate spores are the distinctive marks of the species.

Murrill's determinations of *F. turbinatus* (Pat.) Murr. belong here. The latter species, described from Venezuela, has a similar external appearance but the context hyphae are larger, 4-6 μ in diameter, and the spores are also larger, 13-17 × 7-10 μ. *F. clelandi* Lloyd is very similar to *F. obiensis* but may differ in having a somewhat strigose upper surface, a darker context, and slightly larger context hyphae, 3-6 μ in diameter.

64. Fomes unitus (Pers.) Lowe — Fig. 64

Mycologia 47:222. 1955. *Polyporus unitus* Pers., Myc. Europe 2:93. 1825. *Poria medulla-panis* (Pers.) Cooke, sense of Bresadola in Atti Acad. Sci. Lett. Art. Agiati Rovereto 3, 3:84. 1897.

Sporophore usually resupinate and widely effused, rarely effused-reflexed, hard and woody; pileus reflexed up to 1 cm., convex to ungulate, up to 1 cm. thick, the upper surface brownish-black to black, glabrous, narrowly sulcate, the margin cream or reddish, quickly darkening; pore surface cream or pinkish, slightly glistening, the pores round to angular, 5-8 per mm., edges remaining thick or rather thick, entire. Context white or darkening to somewhat brownish, fragile, corky, eventually with a thin crust, bitter, up to 2 mm. thick; tubes distinctly to indistinctly stratified, corky-fragile, up to 3 mm. long in each layer.

Context hyphae frequently intricately branched, thick-walled to solid, nonseptate, 1.5-3 μ in diameter; tramal hyphae similar; hymenial layer 11-13 μ thick; cystidia none; basidia clavate, 9-11 × 5-9 μ; spores hyaline, smooth, oblong-ellipsoid to oval or subglobose, often truncate, 4-7 × 2.5-5 μ.

On the wood of deciduous or rarely of coniferous trees from Quebec to Georgia westward to the prairies, and in Colorado and California; in S. America and Europe. Pileate specimens have been seen from Georgia only.

The fungus is associated with a white rot, often on dry wood, such as structural timbers, fence posts, and fence rails.

bb. *Spores rounded at both ends (except no. 68)*

65. Fomes officinalis (Vill. ex Fries) Faull — Fig. 65

Royal Canad. Inst. Trans. 11:185. 1916. *Boletus officinalis* Vill., Hist. Plant. Dauph. 3:1041. 1789. *Polyporus officinalis* Vill. ex Fries, Syst. Myc. 1:365. 1821. *Fomes albogriseus* Peck, Torrey Bot. Club Bul. 30:97. 1903 (NYS). *Fomes laricis* Jacq. ex Murr. in Torrey Bot. Club Bul. 30:230. 1903.

Sporophore sessile or sometimes attached at the vertex, woody; pileus ungulate or often elongate, up to 30 × 30 × 65 cm., the upper surface white, yellowish, or grayish, glabrous, sulcate, the margin obtuse; pore surface white or whitish, sometimes glistening, the pores round to angular, averaging 3-4 per mm., edges rather thick to moderately thick, entire. Context white or whitish, "tough when fresh" (Faull), friable in dry specimens, bitter to the taste, up to 5 cm. thick; tubes indistinctly stratified, soon becoming white-stuffed, up to 8 mm. long in a layer.

Context a variable mixture of rarely branched, nearly solid, nonseptate hyphae 3-5 μ in diameter, and thin-walled hyphae, some rather uniform, 3-4 μ in diameter and clamped, others and often the greater part extremely variable in diameter, 3-25 μ, septate, or with abortive clamps; tramal hyphae also of two kinds, some solid, nonseptate, some thin-walled and clamped, 3-4 μ in diameter; hymenial layer 13-16 μ thick; cystidioles hairlike, about 3 μ in diameter; basidia clavate, 13-16 × 6-7 μ; spores hyaline, smooth, ellipsoid to ovoid, 4-5.5 × 3-4 μ.

On the wood of gymnosperms from Ontario westward to the mountains and northward from Arizona and California to Alaska; found throughout the North Temperate Zone. The fruiting bodies are the commercial source of the pharmaceutical agaricin, which accounts for the extraordinarily bitter taste.

The fungus is associated with a brown trunk rot, see Cartwright and Findlay, 1950, p. 79; Faull, Royal Canad. Inst. Trans. 11:185-209. 1916; and Boyce (1948, pp. 420-423).

FIGS. 64a and 65a. — Habit, respectively, of *Fomes unitus* × 1 (Lowe 3861), and of *F. officinalis* × ½ (specimen in College of Forestry Herbarium). FIGS. 64b and 65b. — Context hyphae and spores from the same, and in 65b, hairlike cystidia.

66. Fomes pinicola (Swartz ex Fries) Cooke — Fig. 66

Grevillea 14:17. 1885. *Boletus pinicola* Swartz, Kongl. Vetensk.-Acad. Handl. for 1810, p. 88. 1810. *Polyporus pinicola* Swartz ex Fries, Syst. Myc. 1:372. 1821. *Fomes ungulatus* Schaeff. ex Sacc. in Syll. Fung. 6:167. 1888 and Murrill in North Amer. Flora 9:98. 1908. *Polyporus* (*Fomes*) *ponderosus* von Schrenk, U. S. Dept. Agr. Pl. Ind. Bul. 36:30. 1903 (NY). *Boletus marginatus* Pers., Obs. Myc. 2:6. 1799 (according to European authors).

Sporophore sessile, woody; pileus convex to ungulate, up to 15 × 20 × 10 cm., the upper surface at first often covered with a reddish resinous layer which may persist at the margin, becoming dry, and varying in color from grayish to black, glabrous, usually rather smooth, sulcate with age, the margin obtuse and frequently of a lighter color than the rest of the pileus; pore surface white to yellowish, and when fresh darkening where bruised, the pores round, averaging 3-5 per mm., edges thick, entire. Context pallid to light brown, corky to woody, up to 2 cm. thick; tubes distinctly to indistinctly stratified, corky, up to 7 mm. long in a layer.

Context hyphae rarely branched, thick-walled, nonseptate, 5-8 μ in diameter, with a very small amount of thin-walled, clamped hyphae 2-4 μ in diameter; tramal hyphae similar except mostly 3-5 μ in diameter; hymenial layer 13-14 μ thick; cystidia hairlike, tapering upwards, 2-3.5 μ in diameter, projecting up to 30 μ beyond the hymenium; basidia clavate, 11-13 × 5-8 μ; spores hyaline, smooth, apiculate, ellipsoid to ovoid, 5-7 × 3-4 μ.

Common on the wood of gymnosperms or occasionally of angiosperms from New Brunswick to North Carolina, west to California and Alaska, and in Mexico and Haiti; distributed throughout the North Temperate Zone. The sporophore is most similar to that of *F. annosus* which has, however, a much thinner and usually reflexed pileus, larger pores 2-4 per mm., and somewhat shorter spores, 4.5-5 μ long.

The fungus is associated with a brown cubical rot, see Cartwright and Findlay, 1950, p. 67; Jørstad and Juul, Medd. Norske Skogforsoksv. Bd. 6, H. 3, No. 22:327-346, 475-476. 1939; and Irene Mounce, Canada Dept. Agr. Bul. N.S. 111. 1929 (biology).

67. Fomes annosus (Fries) Karst. — Fig. 67

Soc. F. F. Fenn. Meddel. 5:38. 1879. *Polyporus annosus* Fries, Syst. Myc. 1:373. 1821. *Trametes radiciperda* Hartig, Wicht. Krankh. Waldb., p. 62. 1874. *Polyporus irregularis* Underwood, Torrey Bot. Club Bul. 24:85. 1897 (NY).

Sporophore often imbricate, resupinate to effused-reflexed or sessile, corky to woody; pileus usually applanate, up to 10 × 12 × 3 cm., the upper surface at first a uniform light brown, darker with age or becoming

grayish-brown, and zonate, velvety to nearly glabrous, the annual tube layers loosely cemented together at their margins, thus the surface deeply sulcate; margin acute; pore surface white to yellowish, the pores round to angular, averaging 2-4 per mm., edges moderately thin to rather thin, usually remaining entire. Context whitish, corky, the upper part forming a hard, thin, dark pellicle, up to 1 cm. thick; tubes unevenly and indistinctly stratified, the old tubes usually stuffed, corky, up to 6 mm. long in each layer.

Context hyphae rarely branched, usually nearly solid, nonseptate, 3-6 μ in diameter, mixed with a small amount of thin-walled septate hyphae; tramal hyphae similar except with little or no thin-walled hyphae; hymenial layer 10-13 μ thick; cystidia none; basidia clavate, 10-13 $\times$ 5-7 μ; spores hyaline, smooth, apiculate, ovoid, 4.5-5 $\times$ 3.5-4.5 μ.

On wood of gymnosperms or rarely of angiosperms from the United States, southern Canada, and Alaska, and in Mexico, Guatemala, Jamaica, and Cuba; common in Europe, and found throughout the world. First-year specimens would be looked for in *Trametes* and may be confused with *T. serialis* Fries which has cylindric-ellipsoid spores 7-9 $\times$ 2-3 μ.

The fungus is the cause of a spongy white rot, usually considered of little consequence in America, see Baxter, Michigan Acad. Sci., Arts, Lett. Papers 26:113-118. 1941, and Boyce (1948, p. 104-106). Evidence of serious pathogenicity has been noted on pine in California (Jour. Forestry 44:47-54. 1946) and on eastern red cedar (Jour. Forestry 49:259-262. 1951). In Europe it has long been considered one of the most serious pathogens of conifers, see Wilson, Brit. Myc. Soc. Trans. 12:147-149. 1927; Roll-Hansen, Meddel. Norske Skogforsøksv. 7(1), No. 24: 1-100. 1940. Rennerfelt, Meddel. Statens Skogsforskningsinst. 35 (8):1-88. 1947; Cartwright and Findlay, 1950, p. 63; and Rishbeth, Ann. Bot. 15 N.S.:1-21, 221-246. 1951.

68. Fomes contrarius Berk. & Curt. FIG. 68

In Cooke, Grevillea 15:21. 1886 (K, BPI, NY).

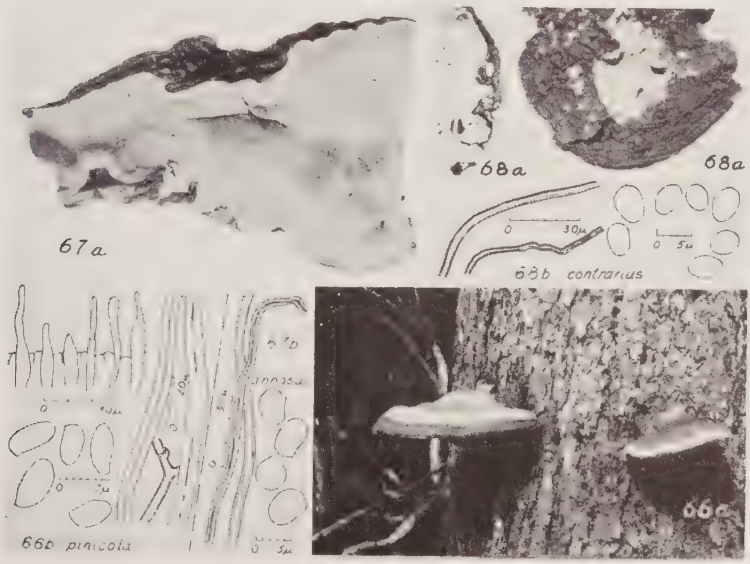
Sporophore pendent but closely appressed and appearing subresupinate, rather rigid, light in weight; pileus effused up to 12 cm., up to 1 cm. thick, the upper surface at first ochraceous, reddening and then darkening to more or less black, matting and soon glabrous, thinly incrusted, shallowly and narrowly sulcate, the margin nearly white, more or less velvety, within quickly darkening, acute; pore surface pale cream, the pores round, 8-9 per mm., edges thick or rather thick, entire. Context cream, soft-fibrous, with a thin crust, up to 1 mm. thick; tubes in distinct layers, each layer up to 1.5 mm. thick.

Context hyphae rarely branched, thin- to thick-walled, nonseptate, 2-4(-5) μ in diameter, the tramal hyphae similar; cystidia none; spores

(not seen attached) hyaline, smooth, oblong-oval to oval, usually more or less truncate, 4-5 × 2-3 μ.

On wood, presumably of angiosperms, and known only from one collection from Cuba. The rot is unknown. The sporophore seems most similar to that of *F. unitus*, which differs in having in age a brownish, corky-fragile context with more slender and frequently intricately branched hyphae 1.5-3 μ in diameter, and somewhat larger spores 4-7 × 2.5-5 μ. It resembles also *F. sulcatus* which is firmer and has much larger spores 5-11 × 3-5 μ. It is quite different from *F. hemileucus*, with which Cooke (who wrote the description) compared it. Lloyd (1915, p. 279) thought it was probably resupinate *F. annosus*, from which it differs markedly in pore size and in the shape and size of the spores.

The concept is based on No. 946, which both Murrill and Bresadola considered the type. No. 938, also listed in the original description, is a sterile specimen different from No. 946, and unknown to me; Bresadola has annotated it as being *Polyporus venezuelae* Berk. & Curt. and *P. hemileucus* forma.



FIGS. 66a, 67a, and 68a. — Habit, respectively, of *Fomes pinicola* about × 1/10, of *F. annosus* × 1/3 (Lowe 6025), and of the pore surface and upper surface of *F. contrarius* × 1/2 (Fungi Cubenses Wrightiani 946 at FH). FIGS. 66b, 67b, and 68b. — Context hyphae, and spores of the same, except 66b with cystidia added from Lowe 6452; 68b from lectotype specimen, No. 946 at Kew.

OMITTED SPECIES

Polyporus aegerita Fries. Described from Mexico. The type does not now exist and the original description is not adequate to place the fungus.

Fomes baccharidis (Pat.) Lloyd. Type (FH, BPI, NY) and other collections are known from Ecuador; reported from Guadeloupe by Murrill (1915b, p. 80) but specimen not found. See also discussion under 39. *F. robustus.*

Fomes bistratosus (Berk. & Cooke) Cooke. Reported from the West Indies. The specimen (Elliott 1283 in BM) appears to be the same as the type of *Poria vincta* (Berk.) Cooke.

Fomes calvescens (Berk.) Cooke. Type material from Louisiana (K, BPI) is a sterile sporophore similar or identical to *Polyporus venezuelae* Berk. The type material of each of these species has only one layer of tubes.

Fomes caryophylleus Cooke. Specimens from North America so named do not correspond to the type (at K) from Brazil. Type is applanate, 8 × 9 × 1 cm., dull reddish brown and matted-velvety above; pores 7-8 per mm.; context dark rusty brown, rather soft, the context hyphae septate, 4-9 μ in diameter; setae few, with tips often curved, ventricose, 16-30 × 8-13 μ; spores pale yellowish- to distinctly reddish-brown, oblong-oval, 4.5-5 × 3-3.5 μ. Known only from Brazil. Not to be confused with *F. caryophylli* (Racib.) Bres., described from Java.

Fomes chilensis (Fries) Cooke. The specimen (BPI) issued as No. 113 in C. L. Smith's Central American Fungi is *Fomes linteus.*

Polyporus crocitinctus Berk. & Curt. This species, placed in *Fomes* by Cooke, forms an annual sporophore.

Polyporus elatus Lév. Type from Guadeloupe; specimen not at Paris.

Fomes endotheius (Berk.) Cooke. The specimen reported from Trinidad (Seaver 3491) is *F. swieteniae.* See also under 5. *F. fastuosus.*

Polyporus ferreus Berk. The Cuban collection (Wright 813) appears to be a mixed collection; material at Kew is probably *F. melanoporus;* at BPI and FH it is *F. dochmius.* The species is known only from the Far East.

Trametes gausapata Berk. & Rav. Type specimen (Ravenel No. 1327 at K) is *Trametes carbonaria* Berk. & Curt.; another American specimen (Ravenel No. 2922 at K) is *Irpex farinaceus* Fries.

Trametes gilvoides Lloyd. This species, placed in synonomy with *F. viticola* by Overholts (1953), appears to be an annual plant.

Polyporus hyperboreus Berk. Type not at Kew. Believed by Murrill to be a synonym of *F. igniarius.*

Fomes inflexibilis (Berk.) Cooke. A valid species known only from the type from Brazil. North American collections so named by Murrill are referred to other species. The type specimen (Spruce 52 at K, BPI) is nearly resupinate. Although well-developed it is sterile and its identity is as yet uncertain. It seems doubtful, however, that it is the same as *F. lividus,* as Bresadola indicates (Icon. Mycol. 21, plate 1001, 2. 1932). The paratype (Spruce 181 at K, BPI, FH) is a quite different plant and fertile. A valid name for it is unknown to me.

Fomes korthalsii (Lév.) Cooke. Specimen reported by Léveillé (PC) appears to be *Polyporus licnoides* Mont.; no other specimens seen.

Fomes lignosus (Klotzsch) Cooke. A tropical species said to be distributed around the world. It is in the complex of species that includes *F. subferianus* and *F. ulmarius;* its exact identity is, however, quite uncertain. See comments under 60. *F. ulmarius.*

Fomes martius (Berk.) Cooke. Although reported from Central America and the West Indies by Lloyd (1915, p. 215) only one specimen so named has been seen. See comments under 58. *F. ligneus.*

Fomes meliae (Underwood) Murr. A species with ordinarily annual sporophores which may, on occasion, persist for another year or two. It has been confused with persisting specimens of *Polyporus submurinus* (Murr.) Lloyd and with *Fomes connatus.*

Polyporus nicaraguensis Berk. & Curt. Type specimen not at Kew nor at the Farlow Herbarium. Its identity is unknown.

Polyporus novae-angliae Berk. & Curt. Type (K) is a single small specimen said to be from New England. Specimen does not agree with any North American species known to me. The hymenium contains hyphomycete spores like those often found on tropical material, and the specimen may have come from there.

Polyporus plebius var. *cubensis* Berk. Described from Cuba. The 5 original collections (K) are referable to 3 species, and the name should, therefore, be discarded as a name of uncertain application.

Polyporus rhabarbarinus Berk. Type material (K) is from an unknown locality, "probably from Brazil"; no North American collections are known. The type is a large specimen, with a blackish strong crust; bright yellowish-brown context; pores 9-10 per mm.; setae usually subulate, 15-21 × 5-8 μ; and spores not found. Externally it resembles *F. pseudosenex;* internally the bright context and presence of setae seem distinctive. Compare also *F. rheicolor* below.

Fomes rheicolor Lloyd. Reported by Overholts from Puerto Rico; later, in his manual (Overholts, 1953), placed in synonomy with *Polyporus porrectus* (Murr.) Sacc. & Trott. The type (BPI) from Argentina is rather large, with a dark thin crust; bright yellow-brown context; pores 8-10 per mm.; context hyphae very thin-walled, septate, contrasting markedly with a much more compact trama; setae frequent, 13-21 × 5-6 μ; spores not found. The sporophore resembles that of *F. rhabarbarinus* somewhat but lacks the strong crust.

Fomes roburneus (Fries) Cooke. Specimens reported by Lloyd appear to be typical *F. igniarius.*

Polyporus rudis Lév. Described from Guadeloupe; not found at Paris. Not to be confused with *Xanthochrous rudis* Pat., a species rather similar to *F. everhartii.*

Fomes rufo-atratus (Berk.) Cooke. The specimen in C. L. Smith's Central American Fungi is a stipitate *Polyporus.*

Polyporus rufo-flavus Berk. & Curt. Isotype material (FH) appears to be an annual sporophore in the same species complex as *F. auberianus.*

Fomes rugulosus (Lév.) Cooke. Specimen reported from Puerto Rico has not been found.

Polyporus sclerodes Berk. Types and paratypes are not at Kew. Material at the Farlow Herbarium, apparently authentic, is sterile and its relation to the species here treated is unknown. It can be placed provisionally with the setulose species in Section Two.

Polyporus scleromyces Berk. & Curt. Types and isotypes (K, BPI) are sterile. *Polyporus vibratilis* Berk. & Curt. and *Poria bracei* Murr. appear to be synonyms. According to Bresadola (herbarium notes) it scarcely differs from *F. semitostus* (Berk.) Cooke. See also comments under 26. *F. subflexibilis.*

Fomes senex (Nees & Mont.) Cooke. Type at Paris is sterile; surely a hyaline-spored plant. No North American sporophores have been seen which agree with the type. See comments under 34. *F. taxodii.*

Polyporus subfulvus Cooke. Change of name for *Polyporus rudis* Lév.

Fomes torulosus (Pers.) Lloyd. Specimens reported by Lloyd (1915, p. 244) and Overholts (1953, p. 71) appear to be perennial specimens of *Polyporus licnoides* Mont. See comments under 34. *F. taxodii.*

Fomes turbinatus (Pat.) Murr. Murrill's determinations from North America are referred to 63. *F. ohiensis.* See comments under that species.

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ADDITIONAL NOTES

The type of *Fomes spadiceus* (Berk.) Cooke, at Kew, was examined after this manuscript was submitted for publication. A collection from Cuba (NY, Britton & Wilson 14582) agrees exactly with this. This collection, and other similar ones, are included in the description of *F. fastuosus*. Specimens of *F. spadiceus* may have to be segregated from material formerly named *F. fastuosus*, or *F. spadiceus* may be the valid name for all of the material included in this manual under the name of *F. fastuosus*. As the actual type of *F. fastuosus* has not been found at Paris, it appears better to keep these two species separate for the present, on the basis of the following differences in the type material:

Fomes fastuosus	*Fomes spadiceus*
Broadly zonate above	Narrowly zonate above
Context bright yellowish brown	Context dull and rather pale yellowish brown
Context hyphae mostly 4-6 μ in diameter	Context hyphae mostly 3-5 μ in diameter
Spores mostly 5-6 μ long	Spores mostly 4.5-5 μ long

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CORRECTIONS

Page 11, line 11 for "14" read "12"

Page 73, 8a. for "84" read "81"